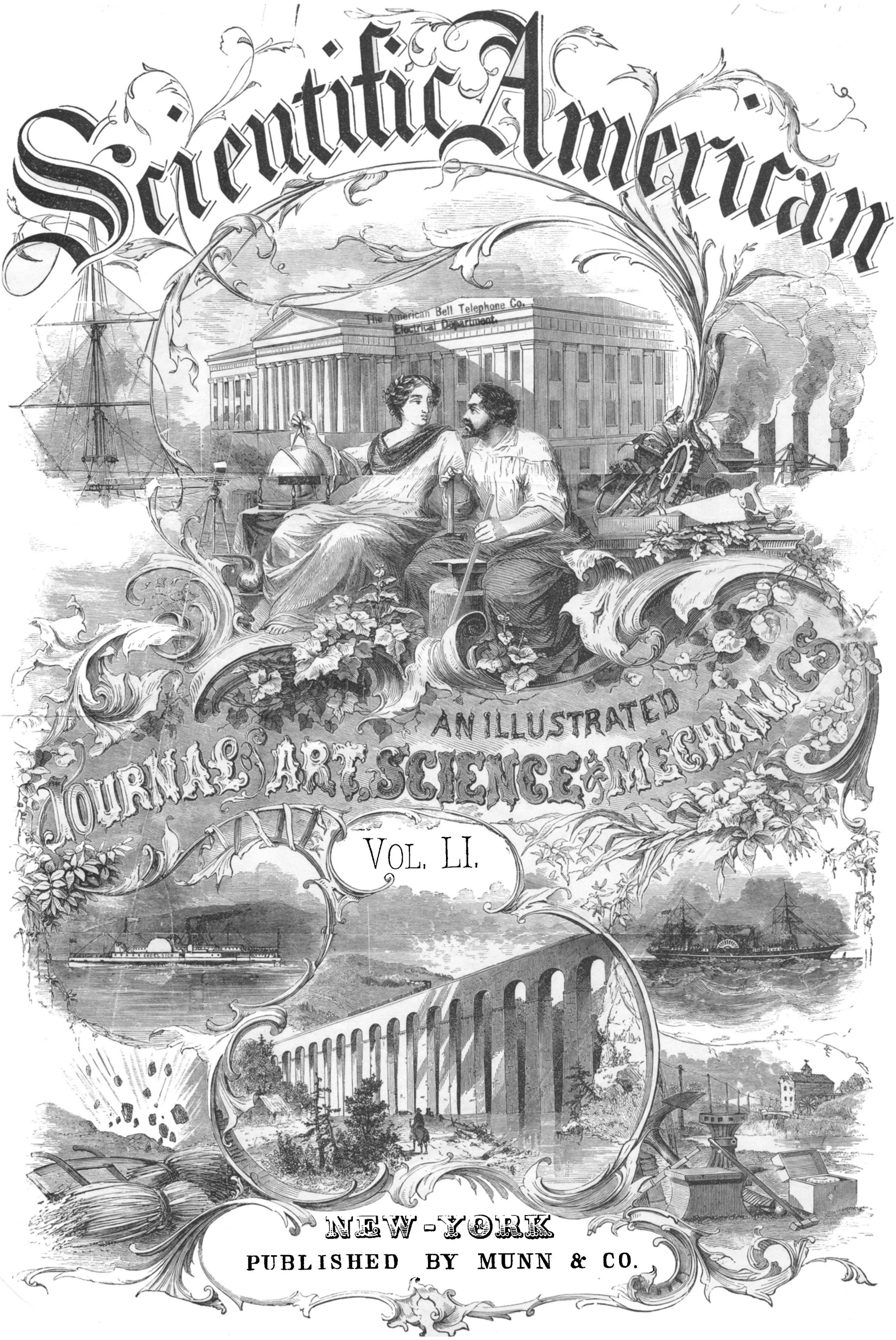
# Scientific American

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VOL. LI.

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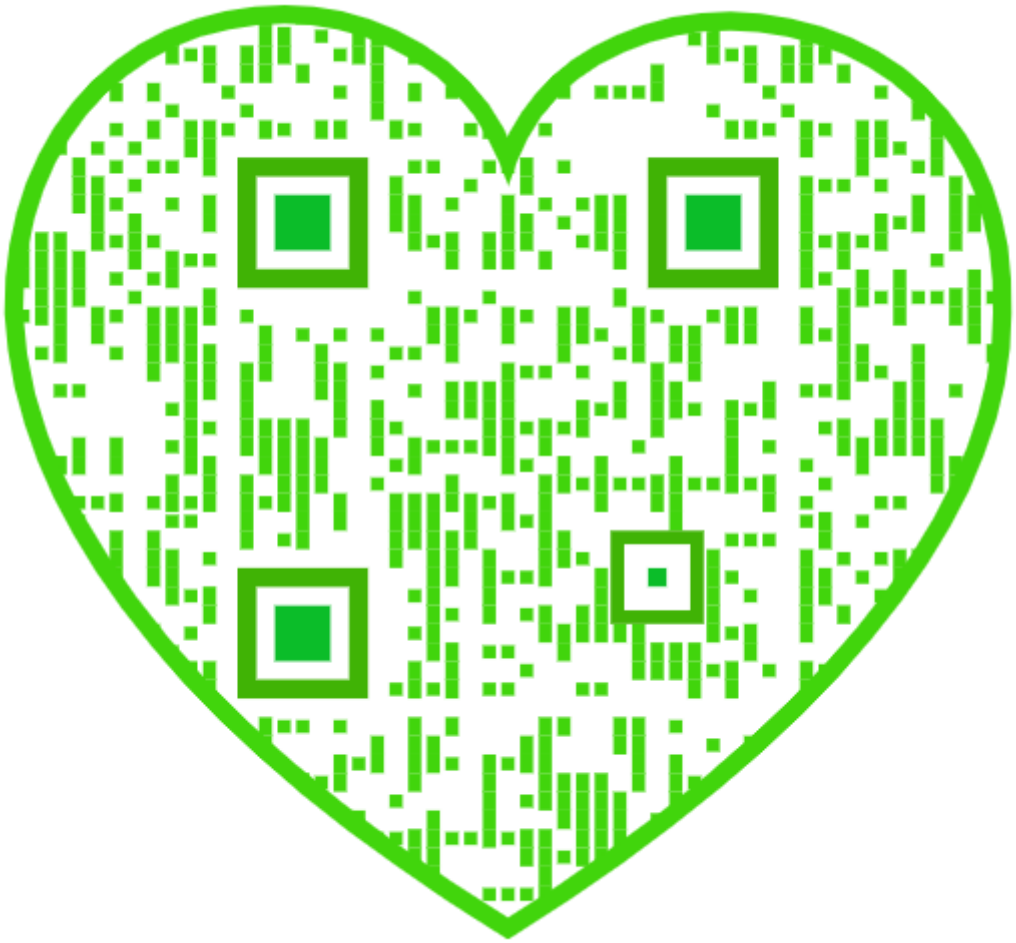

# SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

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## THE GASKILL STEAM PUMPING ENGINES.

The matter of obtaining increased water supply for cities, and the introduction of water in new places by artificial means, under pressure, for domestic use and the extinguishing of fires, are subjects which have deservedly received the most careful consideration from engineers, and are steadily being subjected to closer examination by the public. As pumping engines have been largely used for the purpose of affording such water supply, by either pumping into reservoirs, whence the water is distributed by pipes, or by pumping direct into the water mains, the demand on account of such use has led to a large degree of attention being paid to their improvement.

There has been, therefore, a keen competition among the manufacturers of pumping engines to produce machinery of comparatively low first cost, that will require a minimum of expense for care and maintenance, and that will give the largest amount of duty for the fuel consumed. In this line the Holly Manufacturing Company, of Lockport, N. Y., has been eminently successful. The company manufactures steam pumps of all sizes, and for every variety of service, but it has attained its wide reputation principally on account of the success it has achieved in furnishing pumping engines for the supply of water for cities and towns under the Holly system. According to the principle of this system, the machinery forces the water directly into the street mains, without the necessity of a standpipe or a reservoir, the amount of water to be furnished being susceptible of regulation automatically, according to what is drawn for daily or hourly use, up to the limit provided.

The pressure or head at which the water shall be furnished is likewise fixed at a certain average, but with provision for largely increasing it in cases of emergency, as for fires, when sufficient pressure can be put on the water in the mains to allow of the hose being directly attached, and streams thus thrown equal to those obtained by a steam fire engine. This perfect regulation of the pressure is attained by the use of the Holly hydrostatic automatic regulator, which relieves the engineer from almost constant attention at the throttle valve, and takes away all tendency to "water hammering," as often seen in other well known pumping engines, and entirely removes from the machinery, mains, and service pipes the strains due to constantly changing pressures, while also effecting a great saving in fuel and in the wages for attendance.

Although the Holly system has now been prominently before the country for more than ten years, its steadily increasing adoption has been largely due to the great improvements this company has originated in pumping engines. Mr. Harvey F. Gaskill, the engineer and superintendent of the company's works, has made many of these improvements, and the Gaskill horizontal compound pumping engine, shown on this page, represents probably about as excellent a piece of work of this description as was ever built. It is a five million gallon engine—though the contract under which it was built called for only four million gallons of service per day—set up at Saratoga, N. Y., about a year ago, and has been steadily in operation ever since. It regular performance during nineteen weeks of this year is given in the accompanying table, showing a very high degree of economy and efficiency regularly maintained.

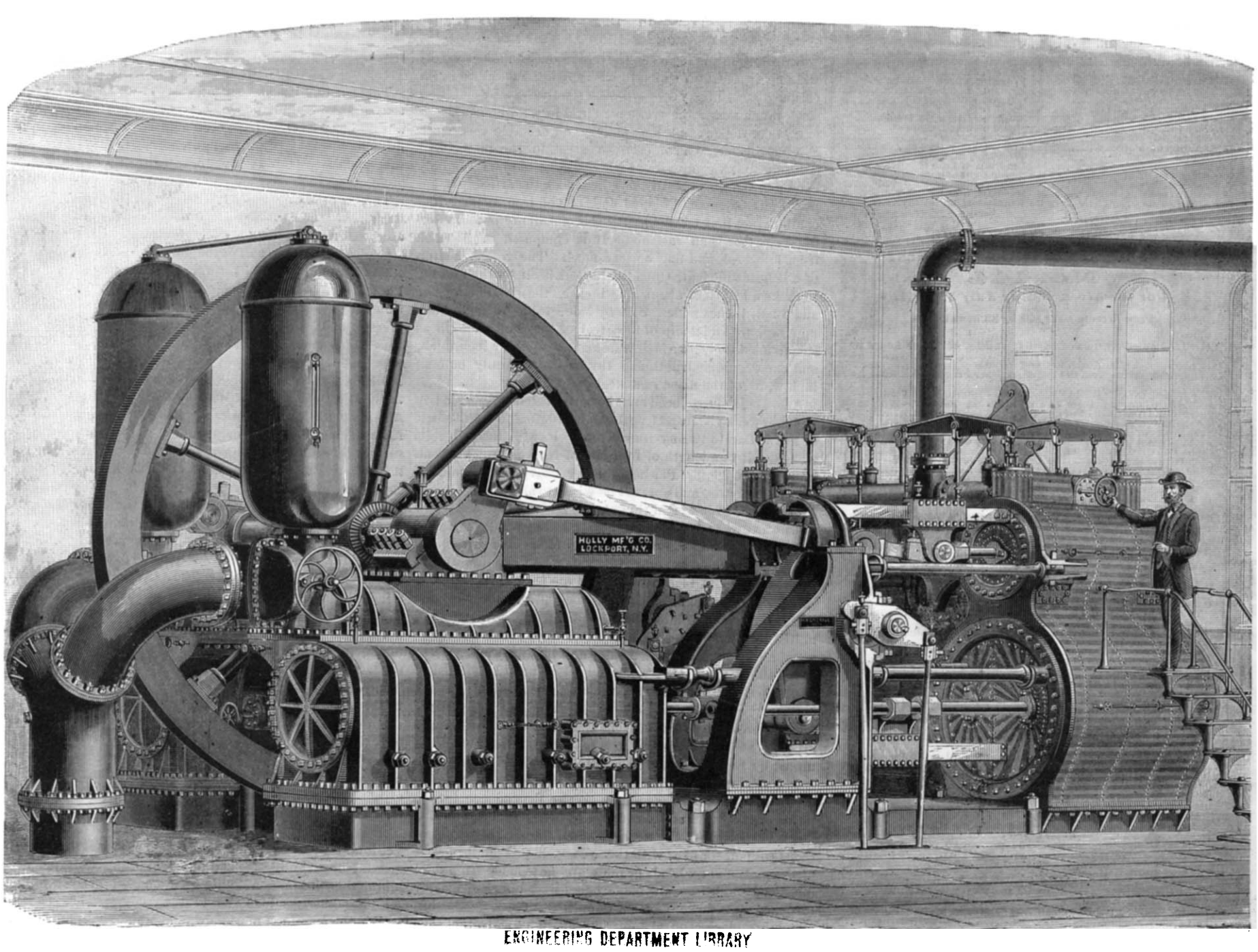
The contract requirements of the engine were a pumping capacity of four million United States gallons in twenty-four hours, working at eighteen revolutions per minute against a pressure of eighty pounds per square inch, and a duty equal to 80,000,000 pounds of water raised. It is impossible for the mains ordinarily to carry all the water so

(*Continued on page 6.*)

Record of the Performance of the Gaskill Pumping Engine, at Saratoga, N. Y.
David L. Holland, Engineer.

| | Revolutions per Week. | Pounds of Coal per Week. | Water Pressure. | Steam Pressure. | Vacuum. | Gallons Pumped per Week. | Duty. |
|---|---|---|---|---|---|---|---|
| January 5, 1884 | 81,070 | 29,500 | 104·16 | 65 | 28·6 | 15,559,278 | 105,37,342 |
| January 12, 1884 | 91,310 | 34,000 | 108·11 | 65 | 28·5 | 17,594,580 | 106,886,417 |
| January 19, 1884 | 92,070 | 33,600 | 105·85 | 65 | 28·5 | 17,670,442 | 106,778,584 |
| January 26, 1884 | 94,670 | 34,700 | 107·3 | 65 | 29 | 18,169,445 | 107,771,966 |
| February 2, 1884 | 95,840 | 34,000 | 105·2 | 65 | 29 | 18,393,996 | 109,170,900 |
| February 9, 1884 | 92,590 | 33,400 | 106·4 | 65 | 29 | 17,770,243 | 108,587,499 |
| February 16, 1884 | 89,090 | 31,900 | 105·88 | 65 | 29 | 17,098,509 | 108,859,770 |
| February 23, 1884 | 85,870 | 30,400 | 105·53 | 65 | 29 | 16,480,513 | 109,740,750 |
| March 1, 1884 | 86,880 | 30,000 | 102·4 | 65 | 29 | 16,674,357 | 109,174,589 |
| March 8, 1884 | 92,210 | 32,500 | 102·14 | 65 | 29 | 17,697,312 | 106,687,477 |
| March 15, 1884 | 42,590 | *14,900 | 102 | 65 | 29 | 8,174,043 | 107,335,834 |
| March 22, 1884 | 63,090 | †22,400 | 102·33 | 60 | 29 | 12,108,485 | 106,105,996 |
| March 29, 1884 | 72,320 | 26,400 | 102 | 60 | 29 | 13,879,943 | 102,867,408 |
| April 5, 1884 | 70,530 | 25,600 | 103 | 60 | 29 | 13,536,399 | 103,456,254 |
| April 12, 1884 | 66,590 | 24,000 | 102 | 60 | 29·5 | 12,780,219 | 104,188,675 |
| April 19, 1884 | 61,980 | 22,400 | 102·3 | 60 | 29 | 11,895,853 | 104,124,060 |
| April 26, 1884 | 59,410 | 22,400 | 103·57 | 60 | 29 | 11,402,204 | 101,127,239 |
| May 3, 1884 | 62,360 | 23,200 | 103·9 | 60 | 29 | 11,968,380 | 102,814,920 |
| May 10, 1884 | 58,020] | 22,400 | 104·3 | 60 | 29 | 11,135,450 | 99,457,194 |
| Average | 79,758 | 28,858 | 104·05 | 62·8 | 28·9 | 15,307,558 | 105,816,459 |

* Run by water power 3½ days. † Run by water power 1½ days.

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NEW YORK, SATURDAY, JULY 5, 1884.


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### A MECHANICAL DICTIONARY NEEDED.

There seems to be need for a dictionary of shop terms as well as of accepted scientific mechanical terms as applied to practice. Even in our most popular technical periodicals the terms used by a contributor from one portion of the country are sometimes unmeaning to readers in another portion.

Lack of definiteness is one of the faults of our mechanical nomenclature. In a recent publication of a mechanical paper, the question whether "spline," "key," and "feather" are synonymous was presented. Perhaps this will be as good as any other instance of our lax system or lack of system. In the shop talk where the writer was "raised," a "spline" would mean a fixed projected portion retained in a shaft and not specially connected with the pulley or other hub. Its synonym would be a "feather." A "key" would be a wedge shaped fastener, with or without a head, fitting corresponding channels in the shaft and the hub, intended to secure the latter at some exact point. And yet "spline" and "key" are used indiscriminately by good mechanics. So long as these appellations are understood to have a definite meaning they have their value; but this value may be confined to the shop, to the section of manufacturing establishments, or to the manufactories where persons mainly of one nationality are employed; outside they may be confusing.

In shop use why should a cylindrical rod of metal be at one time a "bar," again a "shaft," a "spindle," an "arbor"? Or if so used, why not have a shop thesaurus or lexicon that would give the derivation of the words and the reasons for their use? A "bar" shows its origin; it means to hinder, and is applicable to iron only in bars which may be used as obstacles. A "spindle" is derived from the spinning flax spindle older than our civilization, which supposes a tapering shaft rotating on its own axis. "Shaft" comes from our Saxon schaft, an arrow, implying straightness. "Arbor" comes from the Latin, a tree, or a piece to which something may be temporarily affixed.

A "mandrill" is a hand (*manus, L.*) drill. Is the clearer of bored holes a "reamer" or a "rimmer"? Is the top of a machinist's hammer a "pœne," "pane," or "pene"? Why a "broatch"? Why "drift pin" and "tamp pin"? The suggested glossary ought to contain the information that the ordinary screw jawed wrench is not a monkey wrench because of any peculiar tricks it plays in use, but simply because Thomas Munkey, an English mechanic, invented it. Many other suggestions might be made to the ambitious mechanic who will undertake to simplify our mechanical nomenclature by the compilation of a dictionary and glossary of mechanical and shop terms.

### THE UNION OF IRON AND STEEL.

Old time smiths regarded the union of iron and steel by welding as a feat on which to base a reputation, albeit in the earlier times—fifty years ago—the steel was shear or blister steel, much nearer the component iron in welding characteristics than the present fine cutlery or crucible cast steel. But improvements have been so great in the methods of working that a composite article of steel and iron is not only common, but cheap. In some instances the article is composed of two grades of steel and one of iron, a three-fold combination that when completed is essentially one. The ordinary scythe is an instance. It is composed of Swedish iron, low steel, and fine cutlery steel. The iron is a strap of a length sufficient, when doubled on itself by the middle, to make a length of about five inches, the strap being one and a half inches wide. Side by side, inside this doubled-up strap, are laid a slip of low steel of the same length as the doubled strap, one inch wide and one-quarter inch thick, and one of similar length and thickness, but only half an inch wide, of the finest cast steel.

A flux being introduced and the parts heated together, a trip hammer welds them and lengthens the original four and a half or five inches to twenty-four inches. Passing through rolls elongates it to a length of four feet of the same thickness on back and edge. "Plating" under heavy trip hammers edges the scythe, and spreads its width to about four inches. The blade is so long and thin at this stage that it will bend downward when held by one end, the sides being in a vertical position. But when the back, which contains the low steel, is corrugated by means of a V-hammer and dies, the result is a very stiff blade, resistant to wet grass or the silicious stalks of ripened maize. During the entire processes, the iron, even on the thin edge, is coherent, and is as strongly united, as a mere film, to the steel as when it was one-quarter of an inch thick on each side; and it is finally removed, to lay the steel edge bare, only by grinding. If a finished scythe is carefully examined, the only steel visible is a line perhaps one-eighth of an inch wide along the sharp edge, yet the cross section would show a core of low steel and crucible steel, and an envelope of tough, soft iron, all so united by welding as to be barely distinguished by color.

In implements which are subjected to heavy blows, especially from a leverage, as the ax, entire dependence for the union of the steel and iron cannot be placed on the adhering flux and the heat of the weld. Except for special purposes, the strap poll for axes with the wedge-shaped bit is a style of the past, and ax heads or polls are now made from solid blocks of tough iron, the helve hole being punched cleanly through. The lower portion is opened to receive the bit, which is a block "offset" on each side in a die, so that each side presents two shoulders to bear against the receiving iron poll. When this welding is completed, the ax is in a very crude form, and must be hammered to shape. In this case as in that of the scythe, the union of the fine cast steel and the enveloping iron is so close that it appears to be a chemical one on the surfaces rather than one of a mechanical nature; the two dissimilar materials work agreeably together.

The shanks of garden hoes and the handle sheaths of shovels are other instances of this union that are remarkable, mainly because that at the initiatory processes the materials are thinner than those just mentioned. Yet they withstand the subsequent reheatings and hammerings as though they were purely homogeneous.

### NATURAL GAS AS AN INDUSTRIAL FACTOR.

Throughout the region included in the "gas belt," which reaches from the oil regions of Pennsylvania to Moundsville, West Virginia, there is just now a good deal of speculation as to the possibilities of the large use of natural gas for fuel. Pittsburg, with its extensive industries, is advantageously situated to realize the full benefit which may be derived therefrom should the use of this gas be proved practicable, and it is already in use in some large establishments. The largest of these is the Edgar Thomson Steel Works, now using the gas to the value of about 400 tons of coal formerly burnt daily. The Penn Fuel Company, furnishing natural gas, is said to have contracts amounting to $300,000 annually in a single ward of Pittsburg, and there are several other companies owning wells and supplying gas for use as fuel, while others are organizing, and several large yielding wells have recently been opened.

Although it has been known for a long time that gas could thus be had for the boring through all the section where the matter is now receiving so much attention, and it has been employed to a limited extent for some years, it is only within about twelve months past that practical efforts have been made for its utilization in a large way for industrial purposes.

There are some drawbacks to its employment, among which are its great unsteadiness of pressure, and the ever present doubt as to how permanent may be the flow from any given well. It would seem that the first difficulty might be easily remedied by a proper system of valves and holders, and, as the existence of the gas in the earth has been known for an even longer period than we have known of the petroleum, there is probably as good reason for counting upon its continued flow as there is for expecting a steady supply of petroleum. The section of country promising favorably for the boring of gas wells is a comparatively large one, and the successful employment of this natural fuel can hardly fail to have an important bearing upon the future of many of our industries, especially in all branches of the iron manufacture and its related departments.

### HOW GLOBES ARE BUILT.

This heading has no astronomical meaning; it refers to mechanical manipulation. Our library and school educational globes have perhaps been a puzzle to many an inquisitive mind—they being so light, so easily turned on their axis, and so smooth as to appear more like natural exact productions than mechanical constructions.

The material of a globe is a thick, pulpy paper like soft straw board, and this is formed into two hemispheres from disks. A flat disk is cut in gores, or radical pieces, from center to circumference, half of the gores being removed and the others brought together, forming a hemispherical cup. These disks are gored under a cutting press, the dies of which are so exact that the gores come together at their edges to make a perfect hemisphere. The formation is also done by a press with hemispherical mould and die, the edges of the gores being covered with glue. Two of these hemispheres are then united by glue and mounted on a wire, the ends of which are the two axes of the finished globe. All this work is done while the paper is in a moist state. After drying, the rough paper globe is rasped down to a surface by coarse sand paper, followed by finer paper, and then receives a coating of paint or enamel that will take a clean smooth finish.

The instructive portion is a map of the world printed in twelve sections, each of lozenge shape, the points extending from pole to pole, exactly as though the peel of an orange was cut through from stem to bud in twelve equal divisions. These maps are obtained in Scotland generally, although there are two or three establishments otherwheres which produce them. The paper of these maps is very thin but tenacious, and is held to the globe by glue. The operator—generally a woman—begins at one pole, pasting with the left hand and laying the sheet with the right, working along one edge to the north or other pole, coaxing the edge of the paper over the curvature of the globe with an ivory spatula, and working down the entire paper to an absolutely smooth surface.

As there are no laps to these lozenge sections the edges must absolutely meet, else there would be a mixed up mess, especially among the islands of some of the great archipelagoes and in the arbitrary political borders of the nations. This is probably the most exact work in globe making, and yet it appears to be easy because the operator is so expert in coaxing down fullnesses and in expanding scanty portions, all the time keeping absolute relation and perfect joining with the other sections and to their edges. The metallic work—the equators, meridians, and stands—are finished by machinery. A coat of transparent varnish over the paper surface completes the work, and thus a globe is built.

### THE EQUITABLE RIGHTS OF INVENTORS BEFORE CONGRESS.

The Patent Office has an accumulated fund to its credit in the U. S. Treasury of more than two and a half millions of dollars. This sum has been derived from inventors, and is the accrued profit after paying the expenses of conducting the Patent Office, which amount annually to something like seven hundred thousand dollars.

Now, it would seem as if our legislators could not be so oblivious as not to see that the inventors of our country have some claim upon the large surplus to their credit in the Treasury; at least a right to justify their demand of Congress to appropriate sufficient money to pay for an ample force of examiners to enable the work of the Patent Office to be kept up, so that an applicant for a patent need not wait more than a few days for a decision. But it does not seem that the interests of inventors and a proper appreciation of their work is considered by our legislators, and the result is a lack of sufficient appropriation by Congress to enable the Commissioner to employ sufficient help to carry on the business of his office. The examiners are overpressed with work, and in some classes the inventor has to wait from three to six months after his application is filed before his turn is reached and a decision is rendered. Now, this is all wrong, and the inventor, who should be recognized as an important factor in the community, is made a sufferer by the delay. Congress passes laws requiring the inventor to pay his money into the Treasury when his papers for an application for a patent are filed, and he naturally has a right to expect that his case will be promptly acted upon, and it is an injustice to him when it is not. A correspondent in one of our contemporaries says:

"What an outcry there would be if the Post Office was managed after the fashion of our Patent Office. A letter posted to-day *might* then be delivered 4, 6, or 9 months hence, and on inquiry as to the cause of such outrageous delay, the reply *want of sorters and carriers*, would be just as consistent as the present paltry excuses of the Patent Office."

Now, in behalf of the rights of inventors and of all others having business with the Patent Office, we beseech Congress before it adjourns its session to make ample enough appropriation to the Commissioner of Patents, to enable him to employ sufficient force to bring up all the back work of his office to date, and to keep it up, so that no applicant for a patent shall have to wait for a decision more than ten days at the longest after he has paid the requisite fee and complied with all the other requirements of the Patent Office. The appropriation asked for by Commissioner Butterworth for the coming year, from July 1, 1884, to June 30, 1885, is seven hundred and eighty-five thousand dollars, and it is believed by those in position to know that both Houses of Congress will not hesitate to grant the sum asked for. The appropriation bills for all the departments of the Government will probably be acted upon before the 4th of July, and if the amount which seems to be agreed upon by both Houses is allowed the Commissioner of Patents, he will be able to increase his clerical force, and thus be in position to dispatch the work of his office to the better satisfaction of its patrons.

### The Banyan Tree.—(*Ficus Indica.*)

One of the most remarkable trees belonging to the genus Ficus—the 600 species of which comprise climbing shrubs and trees of great diversity of character—is the famous banyan, whose extraordinary habit of growth and enormous proportions so much astonish those whose idea of a large tree has been formed from what we in Europe consider giant forest trees. The banyan, whose spreading, bowery roof, beneath which whole villages of huts find shade and shelter, is supported by gigantic pillar-like props, formed by descending aerial roots, which, on reaching the ground, assume the appearance and perform the functions of separate trunks. The following extract from Tennant's "Ceylon" gives an interesting account of the peculiar habits of this tree, which in many parts of India is held sacred by the natives:

"As we ascend the hills, the banyans and a variety of figs make their appearance. They are the Thugs of the vegetable world; for although not necessarily epiphytic, it may be said that, in point of fact, no single tree comes to perfection, or acquires even partial development, without the destruction of some other on which to fix itself as its supporter. The family generally make their appearance as slender roots, hanging from the crown or trunk of some other tree, generally a palm, among the moist bases of whose leaves the seed, carried thither by some bird which had fed upon the fig, begins to germinate. This root, branching as it descends, envelops the trunk of the supporting tree with a network of wood, and at length, penetrating the ground, attains the dimensions of a stem; but, unlike a stem, it throws out no buds, leaves, or flowers. The true stem, with its branches, its foliage, and fruit springing upward from the crown of the tree, whence the root is seen descending, and from it issue the pendulous rootlets, which on reaching the earth fix themselves firmly and form the marvelous growth for which the banyan is so celebrated. In the depth of this grove the original tree is incarcerated till, literally strangled by the folds and weight of its resistless companion, it dies, and leaves the fig in undisturbed possession of its place. It is not unusual to find a fig tree in the forest which had been thus upborne till it became a standard, now forming a hollow cylinder, the center of which was once filled by the sustaining tree, but the empty walls form a circular network of interlaced roots and branches firmly agglutinating under pressure, and admitting the light through interstices that look like loopholes in a turret."

Deep twilight always prevails under the shade of the spreading foliage, through which not a ray of bright light can pierce, and the awe and dread with which the Buddhist villagers regard this sacred tree is very intelligible. In the Wood Museum at Kew there is a fine specimen of a palm trunk, upon which the strangling growth of a banyan's roots is well shown. The remarkable way in which the roots become united to each other at every point where they touch is observable in the specimen just named. B.

### Meetings of the British and American Associations.

As the British Association for the Advancement of Science meets this year at Montreal, from August 27 to September 2, the American Association meeting will be held at Philadelphia, September 4 to 10, to enable members of the two associations to attend both meetings, and allow of the interchange of courtesies between the members. Fellows of the American Association are invited to join in the meeting at Montreal as honorary members, and those in attendance there, as well as other members of leading scientific societies abroad, are invited to take part in the Philadelphia meeting. It is now probable that the Montreal meeting will be attended by a larger body of foreign savants than were ever before in this country at one time, and as an international electrical exhibition will then be in progress in Philadelphia, with probably an electrical congress, besides the meeting of the American Association, the season promises to be one of material scientific advancement. The officers elected for the Philadelphia meeting include the following: President, J. P. Lesley, of Philadelphia. Vice-Presidents: A. Mathematics and Astronomy—H. T. Eddy, of Cincinnati; B. Physics—John Trowbridge, of Cambridge; C. Chemistry—John W. Langley, of Ann Arbor; D. Mechanical Science—R. H. Thurston, of Hoboken; E. Geology and Geography—N. H. Winchell, of Minneapolis; F. Biology—E. D. Cope, of Philadelphia; G. Histology and Microscopy—T. G. Wormley, of Philadelphia; H. Anthropology—E. S. Morse, of Salem; I. Economic Science and Statistics—John Eaton, of Washington.

### A Catastrophe Averted by Electric Wires.

We learn by a letter from Rev. H. C. Hovey, that the new drill hall of the State University, at Minneapolis, was struck by lightning, on the 12th of June, with attendant phenomena of interest. This building, locally known as the University Colosseum, stands on a bluff overlooking the Falls of St. Anthony, occupying the highest ground in the city. A musical festival was in progress at the time; choruses from Minneapolis and St. Paul being assisted by Nilsson, Materna, and other celebrities, under the general direction of Dr. Theodore Thomas. At 2 P.M. there were 1,000 children assembled on the stage, and about 8,000 persons in the audience. A thunder storm arose, and while the children's choruses were going on, it was noticed that the series of electric lamps, fifteen in number, hanging from the dome, were lighted at each flash of lightning, going out again at once, and there was a sense of uneasiness pervading the people.

Herr Scaria had just opened the rear door of the stage, a solo from him being next in order, when suddenly there was a loud report, as if of heavy ordnance, balls of fire were distinctly seen through the large skylight, and following the electric wires away from the building. Subsequent examination showed that the lightning first struck the flag staff surmounting the door, thence pierced an oaken beam to which the staff was fastened, the splinters, or the concussion, breaking the glass in the skylight. An iron rod conducted the fluid to the network of electric wires below, where the charge was divided, a portion being harmlessly distributed over the general circuit, and the remainder shattering several electric masts near the building.

A workman on the roof had his shoe torn off, and his leg badly burned; and another person in proximity to one of the masts was temporarily paralyzed; two or three ladies fainted away; but that was all the damage sustained! There was a panic imminent at first, as every one instinctively sprang to his feet and confused cries and shouts were uttered. Had those 4,000 people made a rush for the doors, many lives must have been sacrificed. But they were mostly persons of education, trained to obey orders, and accordingly, when told to sit down, they immediately did so. Dr. Thomas, with great presence of mind, had his orchestra play, and Herr Scaria came forward and sang. Thus reassured, people either remained to hear the music, or quietly left the hall. It should be added that, at night, the Colosseum was crowded to its utmost capacity to hear the oratorio of the Creation, and quietly sat through another thunder storm, seemingly satisfied that the electric wires were good lightning rods. The lamps, however, worked fitfully, now blazing with startling brilliancy, and then going completely out, leaving the audience in total darkness, and then flashing up again. Meanwhile the music went on as if nothing unusual had occurred, both soloists and chorus being perfectly familiar with the score!

An impression seems to have gained ground that the lightning was attracted by "the nest of electric wires" clustered in the upper part of the University Colosseum. There is no such "nest," only a pair of insulated copper wires running through the building above the ceiling. What drew the lightning was the metallic ball surmounting the tall flag staff, fifty feet from the wires. The staff and girder to which it was attached were wet, hence became conductors, carrying the fluid along to an iron bolt, beside which it passed through a heavy piece of timber, whence it leaped upon the electric wires, by means of which it escaped from the building. There is not the slightest doubt that the wires performed the duty of lightning rods in this instance, although not put up for that purpose. Nor is there any doubt of the grave error of permitting a vast assembly to be gathered into a lofty building on an eminence, the dome surmounted by a staff tipped with a metallic globe, whereby the lightning was actually invited, with no provision intentionally made for its escape. The intensity of the current fused the fine wire circuit feeding the lamps, which, according to Secretary King, of the Electric Light Company, accounted for the spasmodic working of the lamps at the concert on Thursday night—the wonder being that they should have worked at all after being subjected to such a strain.

Mr. Noyes, foreman of the Brush Company, tells an interesting experience. He was at work on the wires previous to the storm, and kept on after it burst, although aware of his danger. At the moment the building was struck, he was splicing the wires directly above the central lamp, meanwhile taking every precaution possible under the circumstances. For a few minutes he lay unconscious, and then regaining his senses descended to the ground. He says that he did not feel any pain until he reached *terra firma*, when he suffered intensely in his right foot. On examination he found that the bolt had struck his leg below the knee, tearing the clothing to shreds, bursting open his stout boot from heel to toe, and blistering the flesh as if with a hot iron.

### The Simultaneous Firing of Shots.

According to Mr. George G. André, the system of exploding a number of shots simultaneously in rock blasting is making its way slowly into common use. It is surprising that a system offering so many advantages should need so much advocacy. Some portion of the prejudice against it is no doubt due to past failures. But the obvious certainty obtained by using powerful currents, and the ease with which such currents may be applied when the works are lighted by electricity, should be sufficient to induce the disappointed to try again. A good example of the application of the lighting current to the ignition of blasts, and, I believe, the first of its kind, has just come under my notice in Germany. The mine is a colliery, and the surface works are lighted by arc lamps. Underground, a stone drift is driven, and this drift is lighted by incandescent lamps. In the face, from twenty to twenty-four shots are placed, and an electric fuse in each is joined up in parallel circuit by means of bare iron wire and connected with lighting cables in such a way that the current can be shunted from the lamps into the fuses. The result is in the highest degree satisfactory. Misfires are unknown, and the effect is wonderfully good. It is estimated that from twenty-eight to thirty-two shots would be needed if fired in the usual manner in succession; so that the saving of labor is in this case considerable, exceeding 25 per cent, both for the labor of boring and the quantity of explosive required.

### Koumiss.

Koumiss has become a very common article of diet with dyspeptics, and according to the Chicago *Review* it may be made at home at a cost of about 15 cents per quart. The following directions are given for its manufacture: Fill a quart champagne bottle up to the neck with pure milk; add two tablespoonfuls of white sugar, after dissolving the same in a little water over a hot fire; add also a quarter of a two cent cake of compressed yeast. Then tie the cork on the bottle securely, and shake the mixture well; place it in a room of the temperature of 50° to 95° Fahrenheit for six hours, and finally in the ice box over night. Drink in such quantities as the stomach may require.

It will be well to observe several important injunctions in preparing the koumiss, and they are: To be sure that the milk is pure; that the bottle is sound; that the yeast is fresh; to open the mixture in the morning with great care, on account of its effervescent properties; not to drink it at all if there is any curdle or thickening part resembling cheese, as this indicates that the fermentation has been prolonged beyond the proper time. Make it as you need to use it. The virtue of koumiss is that it refreshes and stimulates, with no after reaction from its effects. It is often almost impossible to obtain good fresh koumiss, especially away from large towns. The above makes it possible for any physician to prescribe it.

### Association for the Advancement of Science.

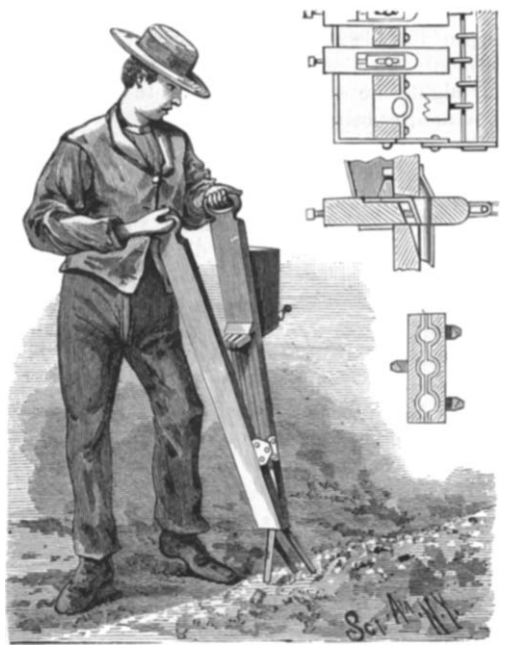
The thirty-third meeting of the American Association for the Advancement of Science will be held at Philadelphia from September 4th to the 10th.

The British Association has invited the members of the American Association to join in the meeting at Montreal, and the American Association has invited the members of the British Association, with their near relatives who may be with them, to take part in the Philadelphia meeting.

A series of receptions will be offered the Association and its guests, including one at the Academy of Music after the president's address. The botanical section of the Academy of Natural Sciences will organize botanical excursions, and also hold a special meeting at the Academy for botanists.

### HAND CORN PLANTER.

The corn planter recently patented by Mr. J. T. Ricketts, of Camargo, Kentucky, deposits the kernels in the ground separate and in a triangular space, so as to make the hills compact and leave as much room as possible between them. To the side edges of the bars of the planter, at a little distance from their lower ends, are attached plates, the adjacent edges of each pair of which are overlapped and hinged to each other by bolts. To the outer side of one bar is secured the seed hopper, from which the seed is removed by the slides which pass through openings in the bar and in the side of the hopper. The inner ends of the slides are



RICKETTS' HAND CORN PLANTER.

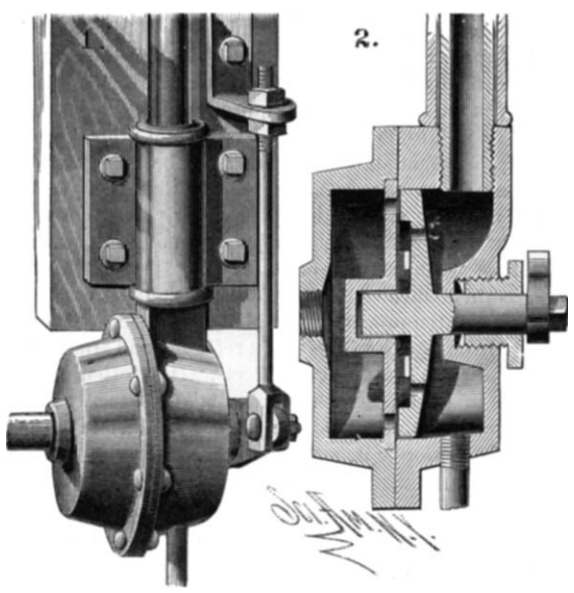
connected with the other bar, so that they will be operated by the opening and closing of the bars. (This construction is shown plainly in the upper view, which is a sectional plan through the slides; the center cut is a vertical section through the slides and hopper. The lower cut is a sectional plan through the lower part of the bars.)

In each slide is formed an opening, to receive the seed and carry it out of the hopper, and the size of which is regulated by plates inserted in the opening and adjusted by hand screws. Brushes attached to the bar above the openings through which the slides work prevent the slides from carrying out any more seed than the openings will hold. The seeds pass through passages formed by covering grooves in the inner side of the bar with semi-cylindrical plates, which extend down to the hinges, where they meet similar plates having their concave sides toward each other. At the lower ends of the bars two pairs of plates are bent forward, and the third pair is bent rearward, so that the lower ends are equidistant from each other.

To use the planter the bars are drawn apart, thereby closing the lower plates and drawing back the slides, and allowing the seeds to drop into the passages. The tubes are then thrust into the soil where the hill is to be planted, when the bars are drawn toward each other, which separates the lower plates and permits the seeds to drop.

### STEAM TRAP.

The valve case is made of two circular cup-shaped plates, bolted together and containing a circular seat having ports




MORSE'S STEAM TRAP.

for the escape of the water condensing in the upright pipe and the first chamber, into the second chamber, from which it flows away through the outlet pipe. In the first chamber, fitted on the circular seat, is a disk valve having ports through it and chambers in the face for the escape of water when these chambers are opened to the ports in the seat, which is effected by the turning of the valve. The valve has a stem that is centered in a socket of the seat and also in a stuffing box, through which it extends to the outside of the case, where it connects with a crank arm, from which a rod extends along the pipe a short distance, and connects with a bracket attached to a wall plate, so as to be held rigidly to shift the valve when the pipe, to which the valve case is attached, expands and contracts, so as to cause the valve to open the ports to allow the water to escape and to close them to prevent the escape of steam after the water has been discharged. As the water flows out, the descending steam heats the pipe, which expands and closes the valve; when the valve closes, the steam condenses, and contracts the pipe so as to open the valve. The valve rod is connected to the bracket by nuts, so that it can be adjusted as required. The first chamber is provided with a waste pipe for blowing out the sediment that collects in the chamber. By this means a simple, efficient, and reliable trap for steam heating apparatus and the like is formed.

This invention has been patented by Mr. Robert B. Morse, of Naugatuck, Conn. The trap is in operation at the Goodyear India Rubber Glove Company's Works at the same place.

### Hope as a Remedy against Disease.

Dr. J. Mortimer Granville has been lately rather severely handled by the medical press of London, because he wrote a letter on this subject to one of the daily papers. He is criticised as having performed an unethical act in thus advertising himself in an unprofessional manner in a lay journal. This question we will leave to our transatlantic brethren, while we say a few words upon the subject matter of his letter.

But little touched upon, hope as a remedy against disease is, if wisely and judiciously employed, one of the most valuable and useful means that the physician can employ. Call it what we may, and reason about it as we please, no man of experience will for an instant question that imagination, the prejudices, the mental condition, the conviction of the patient, in many cases, exerts a most powerful and a most real influence upon the progress and termination of diseased conditions. Has it not happened to every one of our readers (it repeatedly has to us) to discover accidentally, so to speak, a condition of chronic disease, which has evidently been present for years, and yet the patient has maintained fairly good health, and is, at the time of the discovery, in no immediate apparent danger; yet when told that he is afflicted with an incurable disease that may carry him off in a few days, or that he may live for months, immediately wilts, like the sensitive plants when touched, and dies in a day or two?

Again, do we not all know of cases of chronic disease, in persons with a happy, hopeful, contented disposition, disease that we felt sure would soon prove fatal? And yet we see them go on day after day and year after year enjoying apparently good health. Of course we are familiar with and thoroughly recognize the fact that worry, that mental anxiety, is diametrically opposed to good health and long life; and in this fact we recognize the explanation of the influence of depressing opinions and advice; for if we tell a man with a nervous temperament that he *may* die in a few days, from that moment all peace and contentment vanishes from his life, while anxiety, worry, and unrest take possession of his whole being.

The practical point to be deduced from these reflections is that it will redound not only to your patient's advantage, but also to your own professional reputation, to make it a rule always to take the most hopeful view that is possible of the patient's condition, especially when the man or woman is one the "nervous, worrying kind," and always to remember that "hope kept alive" is the great secret of success among quacks. Let us steal their thunder.—*The Med. and Surg. Reporter.*

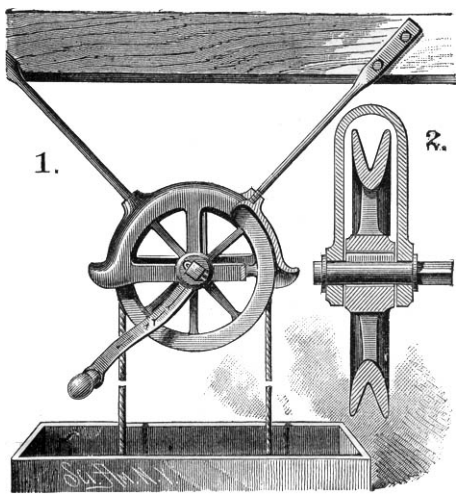
### RAIN WATER TRAP.

At the top of the cistern is arranged a small receiving tank which is divided into two chambers, by a partition, one of which has a spout discharging into the cistern and the other has a pipe discharging into the bucket below. Over the tank is a section of the leader pipe, which is hung on a pivot and connected to a shifting cord by which it will be moved from side to side over the tank, according as the water is to be discharged into one or the other of the chambers. From the pipe the cord extends in opposite directions, connecting on one side with a weighted lever, and on the other side with a lever from which is suspended a float in a tank standing under a spout discharging from the bucket. As the water enters this tank it raises the float, when the weighted lever pulls the pipe so that it will discharge into the chamber leading to the cistern, the roof having been washed clean by the water which escaped through the tank. The center bucket is provided with a waste passage through which most of the water passes away, while some discharges into the lower tank to raise the float, so as not to allow the spout to be shifted too soon. In order to prevent the spout from shifting when the rainfall is not sufficiently heavy to wash the dirt from the roof, but is so continuous that it would raise the float and shift the spout, a notch, placed lower than the outlet pipe, is made at the lower side of the waste passage in the bucket, so that all the water will escape and none will flow into the float tank when the volume of water is too small to thoroughly wash the roof. After the rain is over the water is allowed to flow off from the lower tank, when the float descends and the spout is pulled back over the waste chamber ready for the next rainfall.

This invention has been patented by Mr. E. T. Toomer, of Mobile, Alabama.

### WELL BUCKET WINDLASS.

The supporting frame consists of a pulley cap and spider frames which are cast together, and in the hubs of the spider are formed bearings for the shaft. Upon the upper quarters of the cap are formed bosses in which holes are tapped for connecting the suspension rods by screwing them in. These rods are attached to a board set up edgewise over the well, and supported upon posts placed at opposite sides of the well. The cap is provided with flaring ends to allow of swinging the buckets out over the well curb for emptying them. Keyed upon the shaft is a groove pulley that carries the bucket rope. One end of the shaft is squared to receive the crank. The shank is formed with a key, collar, and groove for ring to prevent its working out, and a squared portion, by casting or in any other suitable way. The groove in the pulley is made plain when a rope is to be used, but is cast with ribs when a chain is to be used. This con-




PALMER'S WELL BUCKET WINDLASS.

struction makes a simple, cheap, and easy working windlass for well buckets.

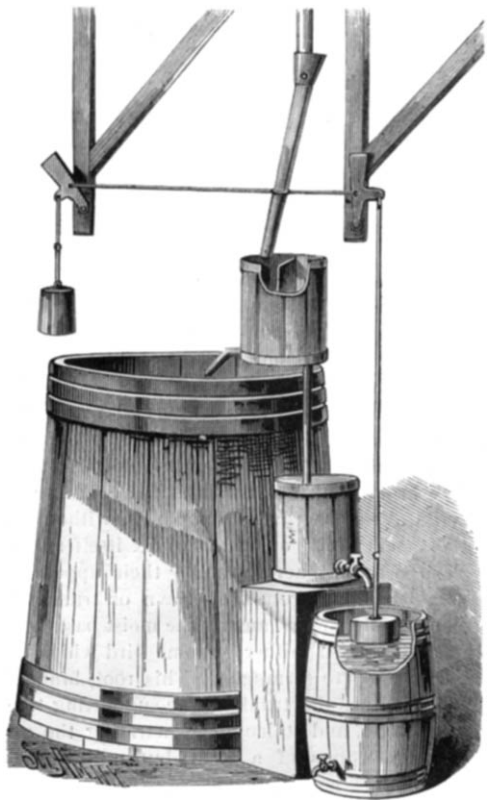
This invention has been patented by Mr. W. W. Palmer, of Nixon, Tenn.

### Curious Experiments.

Among the results of Dr. Guthrie's experiments concerning solutions of salts is, that as a mixture in solution cools, the salt which is present in richest quantity crystallizes out until a certain critical point is reached.

Dr. Guthrie has shown that certain alloys of metal, such as the more fusible or "entectic" alloys, which melt at low temperatures, behave in the same way as mixtures of salts. Moreover, there seems to be no definite molecular proportion obtaining in these alloys. A mixture of 47·38 parts of bismuth, 19·97 of tin, 19·36 of lead, and 13·29 of cadmium fuses at 71 degrees Cent., or a little less than 160 degrees F., or in boiling alcohol. This is still a lower temperature than the fusing of Rose's fusible metal.

Dr. Guthrie has also shown that definite mixtures of water



TOOMER'S RAIN WATER TRAP.

and triethylamine become turbid at or between certain temperatures, and on this basis he has constructed a set of temperature tubes containing the mixtures in question. When placed under the tongue of a patient, the temperature of the body at that point can be ascertained by their means. Dr. Tilden, of Edgbaston, has also shown that mixtures of water and butylic or amylic alcohols become turbid when between 20 degrees and 30 degrees Cent., and clear again between 140 degrees and 158 degrees F.

### The Effect of Incrustation in Steam Boilers.

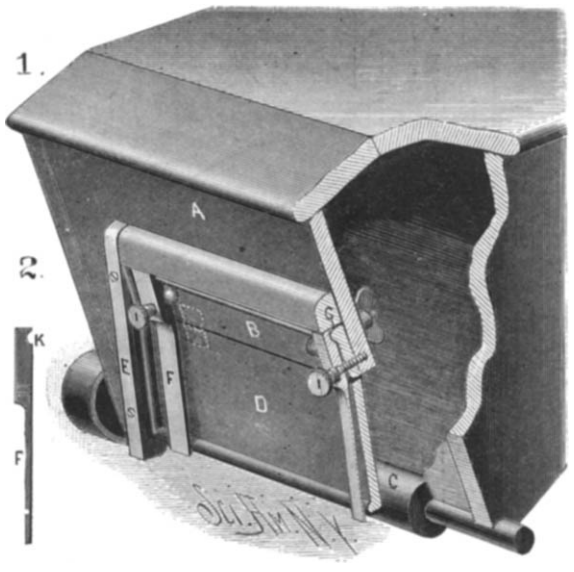
From our foreign exchanges we learn that the Boiler Inspection Association of Munich has been carrying out a series of experiments as to the actual loss resulting from incrustations in boilers. Tests were made with purified water and a perfectly clean heating surface, as compared with the results obtained with ordinary feed water, which had, however, been saturated with gypsum in order to abbreviate the duration of the trials. The principal experiment lasted day and night without intermission during a period of 195 hours. Eight observations were taken, in order to find what change had occurred in the results by reason of the augmented thickness of the incrustation. It will surprise our engineers to learn that although the latter had attained a thickness one-fifth inch to one-third inch, no decrease in the working power could be noticed. Unfortunately, the principal trial had to be interrupted sooner than was intended, as there were indications of the firebox being affected by the heat. The *Eisenzeitung*, in recording these trials, urges the advisability of their being carried out upon a more extensive scale with various descriptions of feed water, different kinds of incrustations being thus produced.

Trials made at Mulhouse would seem to have resulted in a diminution of effect only taking place at the commencement of the experiments, and to a small extent, there being no variation in the later period of the trials. The fact that there is a diminished production of steam, when a boiler has been left a certain length of time without cleaning, is attributed by the journal in question to the heating surface being covered with soot and to the presence of ashes in the flue. The purification of feed water is, however, still recommended on account of the avoidance by this means of the injury and danger arising from the deposit of incrustations or slime upon the fire plate. These experiments confirm Peclet's conclusion that the relative conductivities of heating surfaces in boilers have little or no effect on their efficiency, which is a different thing from their economy. A copper boiler will not make more steam in a given time than an iron boiler of the same dimensions.

### FEEDER FOR MILLS, PURIFIERS, ETC.

Our engraving shows an invention in which the hopper, or other similar feeding device, is provided with a feeding roller applicable to mills, purifiers, and other machines which require an even feed spread over the entire length of the feed roller. The quantity of material fed can be varied without interfering with its uniform distribution over the entire length of the roller. A stationary piece, B, is secured to the front of the hopper by bolts and thumb nuts. Along the front of the bottom of the hopper is arranged the feed roller, C, which may be either smooth or corrugated, and is driven by suitable means. On the front, over the opening, is hinged the swinging valve, D, extending below the center of the roller. Secured to the hopper at the sides of the valve are two strips, E, that prevent lateral scattering of the material being fed. Placed parallel with these strips are springs, F, secured above and having their free ends resting on a flange on the lower edge of the valve, which is thereby closed against the roller. The tension of the springs is regulated by thumb screws, for the purpose of controlling the quantity of material fed over the roller and to suit different substances being operated on without interfering with the uniform spread of the substance over the roller. The upper ends of the springs are thickened and are made with grooves, K (Fig. 2), which fit over a rib, G, on the upper part of the strip, B, for the purpose of holding the springs to their places and to admit of their easy removal, when required.

The apparatus is also applicable to the feeding of substances of different specific gravities, from wheat to the lightest stock made in a mill.




FEEDER FOR MILLS, PURIFIERS, ETC.

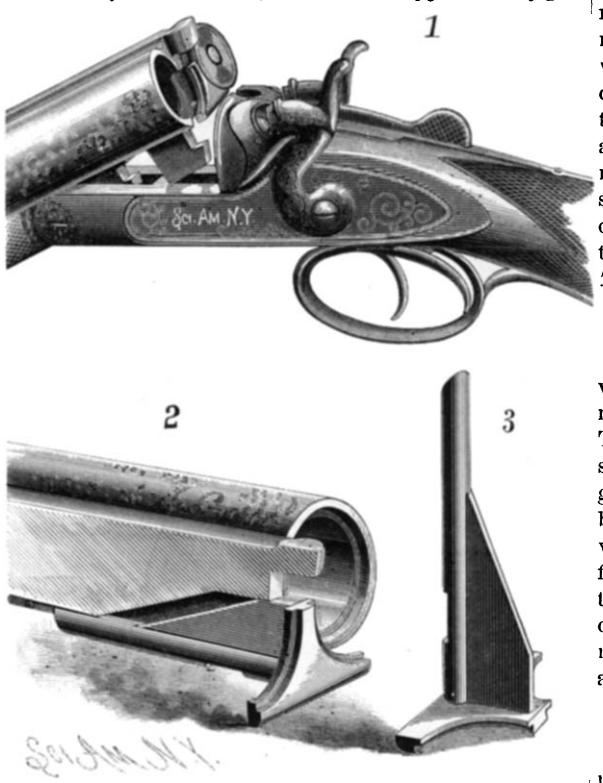
This invention has been patented by Messrs. W. S. Bonnard and W. H. Grupe, and additional particulars may be obtained by addressing the former, in care of Seiberling Milling Company, Akron, O.

A PONDEROUS ledger has just been turned out of the Government bindery for the use of the United States Sub-Treasurer at New York, which weighs 87 pounds, is 8 inches thick, and measures 21 by 32 inches.

### SHELL EXTRACTOR FOR FIRE ARMS.

Fig. 1 is a perspective view of the gun, between the barrels of which the shell extractor (Fig. 3) is placed in any approved manner; Fig. 2 is a sectional elevation between the barrels. The extractor is composed of a stem, a head portion, and a brace which braces the head from the stem. The brace is made of steel in the form of a fin, formed or secured in the angle made by the stem and head, so that while it braces the head, it at the same time stiffens the stem, thus making the extractor strong and rigid in all directions, so that it is as durable as the other working parts of the gun. To avoid the unnecessary cutting of the barrel, the fin is beveled off at its inner end.

The utility of this device, which can be applied to any gun




WAYMIRE'S SHELL EXTRACTOR FOR FIREARMS.

by a gunsmith or machinist, is apparent. The cost is trifling compared with the advantages it possesses.

Full particulars regarding both the United States and English patents may be obtained by addressing the inventor, Mr. N. O. Waymire, of Garfield, Kansas.

### The Oxygen in Water.

At the Royal Institution a lecture on the above named subject by Dr. W. Odling, F.R.S., was recently given.

The lecturer began by stating that in 1823 Faraday proved that a gas or vapor is nothing but a liquid at a temperature above its boiling point; and he exhibited a number of glass tubes containing liquefied gases, which had been prepared by Faraday, who liquefied nearly every known gas. It is only within the last six years, he said, that the five or six gases which had previously resisted liquefaction have been reduced to that state by perfected modern appliances for producing cold and pressure. When gases are dissolved in water they somehow assume the liquid state therein, and increase the bulk of the water. At 0° C. 100 volumes of water dissolve 4·11 volumes of oxygen gas; at 15° C. they dissolve 2·99 volumes. At 0° C. 100 volumes of water dissolve 6,886·10 volumes of sulphurous acid gas; and at 15° C. 4,356·50 volumes. At 0° C. 100 volumes of water dissolve 114,800 volumes of ammonia; and at 15° C. 78,270 volumes. Water at a temperature of 45° Fahr. dissolves 2·199 cubic inches of oxygen per gallon; and at 70° Fahr., 1·797 cubic inches per gallon.

The barometric pressure has a feeble influence in causing variation in the amount of oxygen absorbed by water; the variation not exceeding a small fraction of a grain per gallon. Yet in a large river this means a variation in the quantity of oxygen to be measured by tons. River water in summer contains about 4 grains of oxygen per cubic foot; and about 5 grains in winter. Every 10 million cubic feet of water passing over Teddington Weir carry with them 17¼ tons of liquefied oxygen, or about 50 tons of liquefied air, when the water is at the temperature of 60° Fahr. In August, 1859, Dr. W. Allen Miller ascertained the proportion of oxygen in the Thames at low water, and found that as the Thames runs through London, the quantity of oxygen in it diminishes as compared with the proportion it contains at Richmond. He discovered that about 12 or 13 tons of oxygen are lost between Richmond Bridge and Somerset House.

Other chemists have since taken up the work; and their results agree tolerably closely. One method of testing the proportion of oxygen in water is by means of hyposulphite of soda—a salt in an inferior state of oxidation to the sulphite. The hyposulphite used is not that employed by photographers, which is properly speaking the thiosulphate of soda. The hyposulphite of soda used in the analysis of water bleaches the ammoniacal solution of oxide of copper; and it deoxidizes indigo, magenta, and iodide of starch. White indigo is made blue by the air in water; but does not do so if hyposulphite of soda is put in the water first, to absorb the oxygen. When water is made blue by indigo, and hyposulphite of soda is afterward added, the latter has the choice of two substances from which to absorb oxygen, and it deoxidizes the air in the water first. Hence the quantity of hyposulphite used before the liquid is bleached affords a method of measuring the proportion of oxygen in water.

When the liquid is just bleached by adding no more hyposulphite of soda than is necessary for the purpose, it can be made blue by driving down air into it, or by pouring it from one vessel to another. Tests of the Thames water show that at Erith (near the sewage outfall) it contains about ½ cubic inch of oxygen per gallon, instead of 2 cubic inches per gallon. But lower down, the proportion of oxygen rises again, until the water is within 10 per cent of its richness in oxygen at Richmond. Thus the considerable power which flowing water possesses of keeping itself sweet and clean is no longer a matter of speculation, but one of positive proof. Still the power, great as it is, may be overtaxed; and it often is overtaxed in some cases when the organic matter is non-living. As to whether it has the power of destroying those minute living organisms which are the germs of certain diseases, there are at present, Dr. Odling admitted, very great differences of opinion among chemists.—*The Journal of Gas Lighting.*

### Vertical Flight of Bullets.

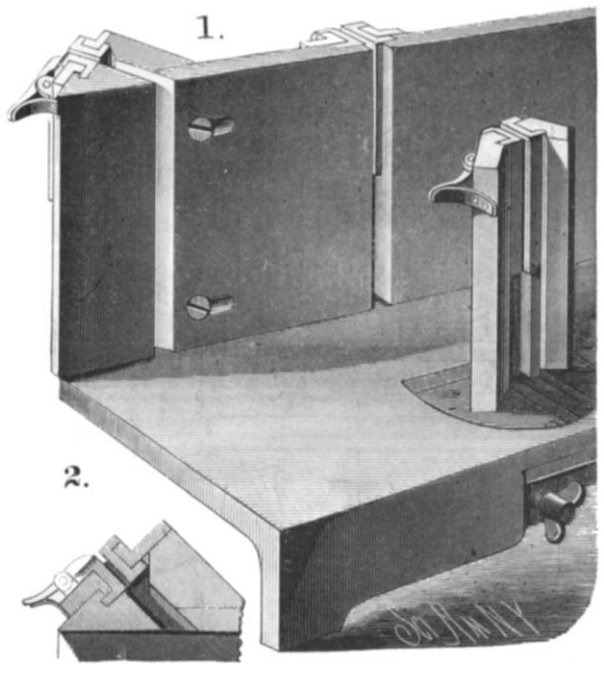
Experiments have been made in Hartford, Conn., with the vertical firing Gatling gun, in the presence of a number of mechanics, military men, and others interested in gunnery. The inclination of the piece was determined by a combined spirit level and quadrant. At an inclination of fifteen degrees, the time between the discharge and the return of the bullets into the river on the banks of which the experiments were made, was fifty-nine seconds. On an exact vertical fire, the time of return was fifty-four seconds. The force of the return of the bullets—44 caliber rifle—was sufficient to drive them through four inches of pine boards, enough to render any defenses not bombproofs untenable against such a shower.

### MITER BOX.

The accompanying engraving shows an invention lately patented by Mr. Joseph Cashin, of Newport News, Va. To one edge of the base of the box is attached a side plate having vertical slots, upon opposite sides of which an attached guide bars by bolts or screws inserted in transverse slots, to allow the bars to be adjusted toward or from each other. Between each pair of bars is a pair of slides provided with grooves by which they are held as they slide up and down, and which are connected together by a projection on the face of one fitting in an opening in the other. One of the slides has a beveled end and a notch in which engages a spring catch (Fig. 2) attached to the upper end of one of the guide bars, so as to hold the slides at the upper ends of the slots preparatory to placing the saw in position.

In the base is supported a pair of guide bars that are secured to a plate having a pintle which rotates in a bracket under the base. The lower ends of the bars have flanges by which they are bolted to the plate, which is formed with slots so that the bars may be adjusted. The pintle is prevented from turning by a screw. A pair of slides, similar to those above described, is placed on these bars.

An ordinary hand saw, without the extra back commonly used in mitering, is placed between the slides of the bars on




CASHIN'S MITER BOX.

the pintle, and between one of the side slots, and is moved up until its thin back rests against the projections. Then, by releasing the catches, the slides will be supported on the saw by the projections, and will follow the saw down in the operation of sawing. The guide bars on the base may be turned to allow the saw to be placed in any one of the side slots. With this construction the saw may be made to cut any desired depth, and the device may be adjusted to any thickness of saw.

## THE GASKILL STEAM PUMPING ENGINES.

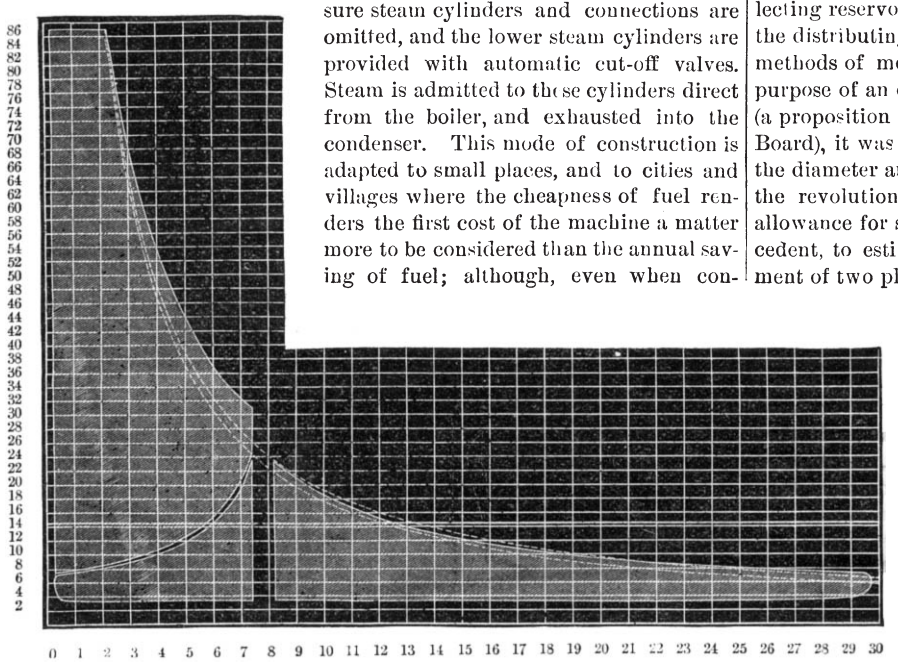
(*Continued from first page.*)

provided for, but it will be seen that in both duty and pressure the average of the engines has been more than 30 per cent above what was called for by the contract.

These pumping engines are thus described: On a pair of iron bed plates are mounted the two pumps, and in direct line therewith the two low pressure steam cylinders, with the piston rods of the low pressure steam cylinders connected to the pump piston rods. Between the pumps and steam cylinders are placed beam supports, which are firmly bolted to the bed plates, and also rigidly stayed by wrought iron struts to the pumps and steam cylinders. These beam supports carry the beam shafts and beams, the lower end of the latter being connected to the cross heads of the low pressure cylinders by means of links.

On the top of the pumps are placed the main shaft bearings, which support the shaft, fly wheel, and cranks, the latter being keyed to the shaft at right angles to each other. On top of the low pressure steam cylinders are mounted the two high pressure steam cylinders, with their centers in the same horizontal plane as the center of the main crank shafts. The cross heads of the high pressure steam cylinders are connected by means of links to the upper ends of the beams, and the beams are in turn connected by means of connecting rods to the crank pins. From the high pressure steam cylinders heavy cast iron girders extend to the pillow blocks. On the inner end of each of the beam centers an arm is keyed, from which the air pumps are driven. The valves of the steam cylinders are operated by means of eccentrics on a shaft, which is driven from the main shaft through small bevel gears. The admission valves to the high pressure steam cylinders are of the double beat poppet pattern, so arranged as to open at the proper time and to close at any desired point of the stroke. The exhaust valves from the high pressure cylinder are also the admission valves to the low pressure steam cylinders, and are ordinary slide valves, remaining open somewhat less than the time required to make a complete stroke. The exhaust valves from the low pressure cylinders are also plain slide valves, operating the same as the high pressure exhaust valves.

The pump plungers are arranged to work through glands in the center of the pumps, and are accessible from the covers at the end of the machine. The pump valves are placed on horizontal plates below and above the line of plunger travel. The glands above mentioned divide the valves of one end of the pump from those of the other end at the center of the valve plates.



The operation of the machine is as follows: Steam is admitted through the automatic cut-off valves into the high pressure steam cylinders, urging the pistons forward under full boiler pressure until the point of cut-off is reached. The valve then closes, and the remaining portion of the stroke is accomplished by the elastic force of the steam. When the piston has nearly reached the end of its travel, the exhaust valve between the high and low pressure cylinders opens, and the steam remaining in the high pressure cylinder rushes into the low pressure cylinder and against its piston, which at that time is at the end of its travel and at the opposite of the high pressure piston. The low pressure cylinder piston is then in turn urged forward by the incoming steam, which is expanded to four times the volume it occupied in the high pressure cylinder at the time of its release therefrom. The release from the low pressure cylinders is accomplished by means of the exhaust valves in the return strokes. This operation is repeated on each side and at each end at proper times. The close connection between the two cylinders reduces the clearance spaces to a minimum, which with thorough jacketing insures the most economical use of steam.

This engine is also built to operate as a non-compound engine, in which case the upper or high pressure steam cylinders and connections are omitted, and the lower steam cylinders are provided with automatic cut-off valves. Steam is admitted to these cylinders direct from the boiler, and exhausted into the condenser. This mode of construction is adapted to small places, and to cities and villages where the cheapness of fuel renders the first cost of the machine a matter more to be considered than the annual saving of fuel; although, even when constructed as a non-compound engine, a duty of 50,000,000 foot pounds of work can be obtained from 100 pounds of coal.

Exhaustive examinations of the working of these engines have been made by engineers of high repute. One of the most thorough tests ever made of such engines in this country was carried through in June, 1883, at the request of the Saratoga Board of Water Commissioners, by Mr. Charles T. Porter, M.E., and former manufacturer of the Porter-Allen high speed engine. The board gave him every facility for making the tests complete, stating that they wished to get at "the exact truth, and know whether the machine could be depended upon for domestic as well as fire purposes."

In making his report Mr. Porter says: "The design of the engines is, in one respect, a novel one. Each high pressure cylinder is placed on the top of a low pressure cylinder. The purpose and effect of this arrangement is, to obtain a short and direct passage for the steam from the first to the second cylinder at each end. With the exception of the beam engine designed by Mr. Leavitt, all previous plans of compound engines of this class have involved long passages between the high and low pressure cylinders, which are wasteful of steam. By the above happy expedient, this objectionable feature is got rid of in these engines, and they are enabled to take rank among the most economical pumping engines. Special interest attaches to this trial, from the fact that these have been the first engines built after this design. In the details through which the general plan has been carried out, there are no features which seem open to criticism, but, on the contrary, all seem entitled to commendation. The construction is thoroughly mechanical in every respect. The forces are transmitted and the strains are resisted in the manner theoretically the most correct. The parts are strong and well proportioned, and the workmanship is excellent. The result is seen in the performance of the highest duty without any sign of labor. I do not think that the study of any machine has ever given to me a stronger feeling of confidence in its durability."

In speaking of a test of the engines as to pressure for fire service, Mr. Porter says: "The machinery satisfactorily demonstrated its ability to run under a water pressure of 140 pounds on the square inch at eighteen revolutions per minute, 'with safety to all its parts.' There was an entire absence of vibration or other indication of labor. If the means had existed for getting rid of the water, I should have increased the speed to thirty revolutions per minute, as guaranteed in the contract. There can, however, be no question of the ability of the machinery to run at that speed, against 140 pounds water pressure, since all its parts then show a large factor of safety. At that speed, it will deliver 95 gallons of water per second, which is more than twice its required capacity. The engines maintain with ease this fire pressure of 140 pounds on the square inch—a pressure the same as would be afforded by a reservoir in which the surface of the water was 320 feet above the level of the pumping station. Now this would be a great head of water; but Saratoga has the very same thing, with the capacity for delivering a volume far greater than can be carried away."

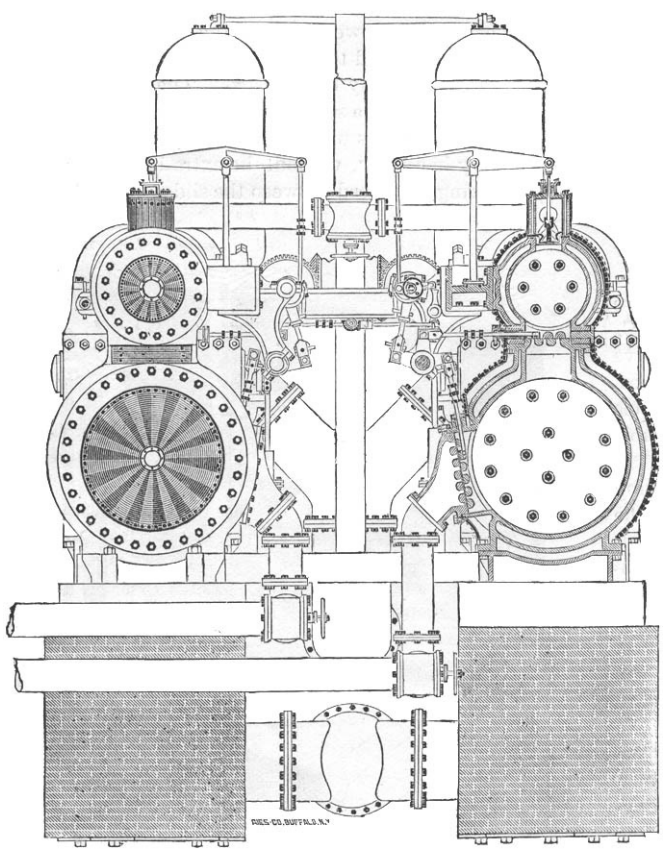
Saratoga is supplied with water for all purposes upon the direct service system, the water being pumped from a collecting reservoir, known as Loughberry Lake, directly into the distributing mains. After canvassing several doubtful methods of measuring the delivery of the pumps, for the purpose of an exact trial, without cutting off the force main (a proposition which could not be entertained by the Water Board), it was finally deemed sufficient to carefully measure the diameter and stroke of plungers, and from this data and the revolutions of engine during the trial, with such an allowance for slip or loss of action as was justified by precedent, to estimate the delivery of pumps. The displacement of two plungers, each 21 inches diameter and 36 inches stroke, with a single rod 4 inches diameter for each revolution of the engine, in United States standard gallons is 191·923. This quantity, reduced by a proper allowance for loss of action (with packing rings and valves tight under pressure), represents the approximate actual delivery of pumps.

The pumps built by the Holly Company for the water supply of Memphis, Tenn., were substantially similar to the pumps of the Saratoga engine, and showed upon measurement by reservoir a delivery of 97.57 and 97·56 per cent of the plunger displacement, so that this trial may be considered an entirely practical one for actual amount of water delivered in the mains.

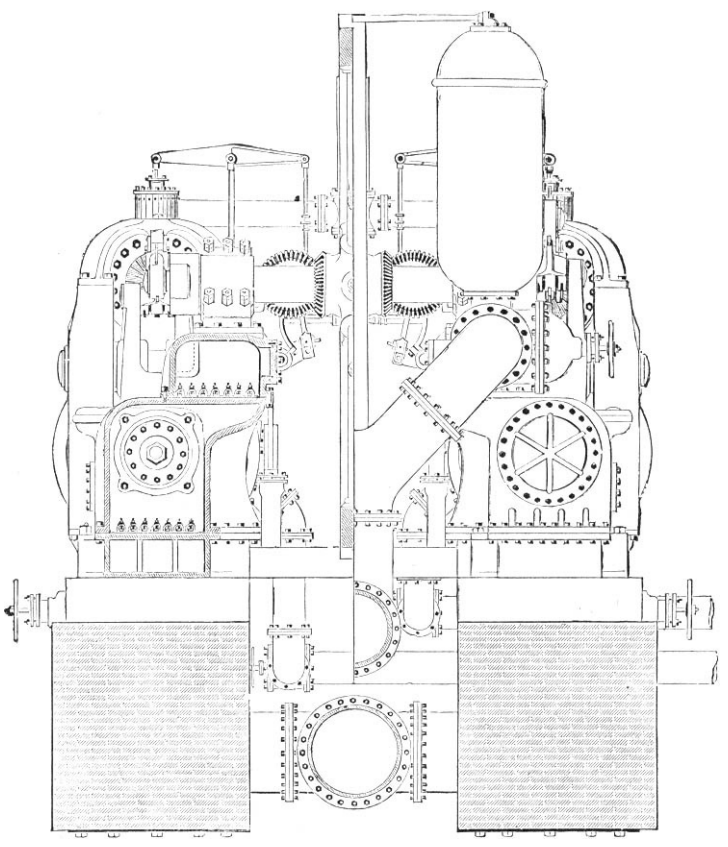
The following are the principal dimensions of the engines:

| | | | | |
|---|---|---|---|---|
| Stroke of all cylinders | | | | 36 in. |
| Diameter high pressure cylinders | | | | 21 " |
| " | " | " | piston rods | 3 " |
| " | low | " | cylinders | 42 " |
| " | " | " | piston rods | 3·5 " |
| Clearance high | | " | cylinder | 2·35 p. ct. |
| " | low | " | " | 2·56 " |
| Diameter of flywheel | | | | 12·33 ft. |
| Weight " | | | | 12,000 lb. |
| Diameter of main shaft | | | | 10 in. |

Mr. Porter's report is accompanied with several indicator diagrams, showing remarkable uniformity in the working of these engines. But they have worked even better since their regular official trials, and we give herewith a diagram more recently taken—a combined diagram—showing the expansion through the high and low pressure cylinders, each division on the vertical scale representing two pounds pressure of steam, and each division on the horizontal scale one cubic foot of steam.



SECTION AND ELEVATION—STEAM END.



SECTION AND ELEVATION—WATER END.

The pumps are provided with by-pass pipes and valves, forming, when the latter are open, a communication between the two chambers of each pump. Their function is this: At the instant of starting, the engines are able to exert only a portion of their power, because no steam has yet been admitted to the low pressure cylinders. The pressure of water is liable to be greater than the steam in the high pres-

sure cylinders alone can overcome. In such a case, the by-pass valves can be opened, when the water flows through them into the opposite chambers, the pressure on the opposite ends of the plungers is in a measure equalized, and the engine is enabled to start. As soon as it is fairly in motion, these valves are closed. They are available, also, when the motion of the engines required to supply the demand for water would be so slow that, on account of the insufficiency of the flywheel, it could not be maintained with the desired regularity, or perhaps not at all. Then, by partially opening these valves, the engines are enabled to run faster, and so to maintain their motion satisfactorily, the excess of water displaced by the plungers passing through them into the chambers that are filling.

The principal dimensions of the pumps are:

| | Feet. | Inches. |
|---|---|---|
| Aggregate length of the two chambers in each pump.. | 7 | 6 |
| Width of the two chambers in each pump..... | 2 | 3 |
| Height of the two chambers in each pump..... | 2 | 11 |
| Capacity of each pump chamber, in cubic feet..... | 25 | |
| Diameter of plunger..... | 0 | 20 |
| Diameter of rod ..... | 0 | 4 |
| Area of plunger, mean of two faces... ..... | 307·88 sq. in. | |
| Stroke of plunger.... ..... | 36 in. | |

As a beautiful as well as most effective specimen of machinery, admirably adapted for the purposes for which it was constructed, the Gaskill pumping engines at Saratoga are well worth the critical examination of all who are interested in obtaining an efficient and economical water supply for cities and villages.

### The Umbrellas and Chairs of Lulu Hurst.

For several months Southern papers have been describing the wonderful performances of a young girl known as Lulu Hurst. These reports have stated that she possessed a unique and extraordinary "force."

We were pleased, therefore, to receive recently a very careful and conscientiously written account of this phenomenon from Dr. Seth N. Jordan, of Columbus, Ga. Dr. Jordan states that, in company with Drs. George Grimes and Carlisle Terry, he examined Miss Hurst, and that they are all agreed that she is not a fraud, but possesses some extraordinary and occult power. He writes that she is fifteen years of age, five feet four inches high, weighs one hundred and twenty-five pounds, is of moderate muscular development, in good general health, has menstruated regularly, is of an intelligent and amiable disposition. She first became aware of the possession of her "force" last September, and it has continued ever since, with the exception of a brief interval when she had a "cold."

Drs. Jordan, Terry, and Grimes, having purchased a new umbrella, experimented with her for four hours in the room of a hotel. The phenomena developed were somewhat as follows: Two or three scientific persons take hold of the handle of an open umbrella, and hold it fast; Miss Lulu then touches it with her open palm, when, presto! the umbrella is turned inside out, or snatched away despite every effort. Meanwhile other persons find that no muscular contractions have taken place in Lulu's arms.

Three strong and scientific men lift up a chair, and hold it in the air. Lulu places her hand upon it, and it sinks to the floor despite every effort. Dr. Jordan and others took hold of a long stick, the phenomenon touched the other end and it rapidly revolved, or pulled the three experimentalists roughly about the room. Miss Hurst's "force" seems to have a peculiar "penchant" for umbrellas and canes, so that she cannot carry the former article at all, the mystical something snatching it away and leaving her out in the wet.

With the exception of the production of knocks and raps, the above are the chief phenomena exhibited and described.

We fully believe that Dr. Jordan has described them correctly, and that Miss Hurst is a remarkable girl. But there is one feature in all her performances which no one, not even Dr. Jordan, seems to have noticed or, at all events, carefully studied. This is, that all the exhibitions of her wonderful force are exhibited in opposing voluntary muscular effort in others. This force has no power over dead matter, but only over living, conscious, muscular exertions. This fact explains, we believe, the mysterious energy which the Georgian phenomenon appears to develop. It is the experimenters, not the subject, who knock themselves and the umbrellas about. At any rate, the matter ought to be investigated from this standpoint. It will probably be found that Miss Hurst's exhibitions are only another phase of the hypnotic phenomena.—*Medical Record.*

### Lecture Room Apparatus.

It is impossible, of course, to make very much headway in a science without a thorough grounding in its theories; still, there can be little doubt that one of the best ways to impart knowledge is to connect in the student's mind some practical application of it. Sometimes this is difficult, if not out of one's power altogether; but still, where feasible, it is the best way of giving instruction. A student, if he once gets interested in the application of a science, will then follow it of his own accord, and require no further incentive. This is exemplified in the lecture room every day; if there is nothing visible but the green baize lecture table and a glass of water, the young student fails to interest from the commencement; if, however, there are plans and diagrams or apparatus and models visible, to supplement the lecturer's words, then scholars are all attention from the commencement. The *Photographic News* (London) claims that photography is a wonderful incentive to the chemical student, just as telegraphy is to the student of physics; and concludes that every one who takes to a branch of applied science of this character ceases at once to be a passive student, and becomes an active one.

### IMPROVED PROPELLER WHEEL.

In the annexed engraving we present the method of Mr. H. C. Pearson, of Ferrysburg, Mich., of improving propeller wheels. He says:

The practice which prevails, the world over, of sharpening both edges of propeller wheel blades, on the forward side of the same, introduces a waste, or loss of power, which has hitherto escaped notice.

The annexed illustration, which shows where and what this leak is, will be readily understood.

Conceive a wheel blade, Fig. 1, to be intersected by the surface of a cylinder, whose axis coincides with the center of the propeller wheel-shaft. And in Fig. 2 let the sectional area A C E represent the developed section thus produced.

Then, the line A B being drawn perpendicular, and the line B C parallel with the shaft, B C will represent the pitch corresponding to width of blade.

Then, if from C we set down the slip (in this case about 18 per cent) to D, B D will represent the net pitch; and the line A D will represent the developed helix, and the direction in which the point A travels in its revolution around the shaft. And, as every point in the section travels in a helix which, when developed, is parallel with the line A D, it follows that a portion of the blade *takes water on the forward side, as from C to E, Fig.* 2 (Fig. 2 shows

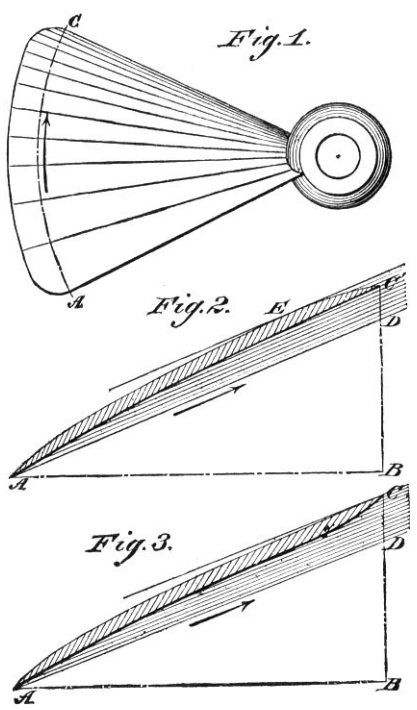



Fig. 2.—Section showing the modern method of sharpening propeller wheel blades. Fig. 3.—Section showing Pearson's method of sharpening wheel blades. Patented February 19, 1884.

### PEARSON'S IMPROVED PROPELLER WHEEL.

from actual measurement a section of a blade made by one of the most popular manufacturers of the country.)

This work on the forward side of blade is the waste referred to. To avoid this loss, sharpen the forward edge of blade on the after side, or face, as illustrated in Fig. 3.

In this manner, a saving of 10 to 15 per cent of the fuel may be made, which is an important consideration to vessels on long voyages.

This saving will be more conspicuous in the fuel account than in the speed, as a saving of 25 per cent of the power would show a gain of only about ¾ of a mile per hour, on a speed of 10 miles per hour.

The cost to the manufacturer is no more than for the ordinary wheel, the only difference in the construction being in the shifting of the bevel that sharpens the forward edge of blade on to the after side, or face, of the same.

Another important advantage gained by this method of sharpening is that we can get hold of the water with a *smaller* pitch-angle, and thereby incur *less slip* and *less loss of power* by oblique action of blade.

This is found to be a very *superior backing wheel*, a quality that will be appreciated by those in charge of harbor towing steamers. In Fig. 3, the curve for the forward side of section should be tangent at C, with a line parallel to A D, for the best results. Mr. Pearson obtained a patent for the above in February of the present year.

### Machine for Curing Tea.

The new tea curing machine is the only one for which a patent (No. 295,290) has ever been granted. Mechanical skill applied to tea curing is as novel as it is desirable. It does away with the slovenly, not to say filthy, practice of rolling and twisting the leaf by hand. It shows the progress the arts are making in ministering to domestic wants. Machine curing undoubtedly supplies a want. The tea treated by it is said to be remarkable for uniformity and cleanness.

## Correspondence.

### Common Troubles with Steam Heating Apparatus.

*To the Editor of the Scientific American:*

We are using a steam heating apparatus, low pressure boiler, horizontal tubular, 50 inches diameter, 16 feet long, with 30 4-inch flues. The furnace is built for *wood* or *coal;* but if I burn coal exclusively for four or five hours, so that the grates become somewhat choked up, the water falls in the gauge glass, and can be heard passing over in the steam pipe. Jarring the doors stops this, nor does it occur when the fire is clean, even when generating steam more rapidly, as in the morning, when raising steam. It takes place, however, later on, when steam is on all the coils. By keeping a space of 2 inches on the sides and front of fire free to admit air through the grates, said action is prevented. We have asked several practical men about the cause, but they do not agree. What we desire to know is this: What is the cause of priming in steam boilers, and its remedy?"

Respectfully, R. D.

St. Mary's, Kan., April 30, 1884.

REMARKS.

There are at times some very interesting phenomena observed in the action of steam, water, fire, and the products of combustion, in a low pressure steam heating apparatus. Many of its irregularities are caused by disproportion between the boiler and the work that it has to do, as well also to the relative size of grate and arrangement for draught.

There are some essential points that are not noticed in the phenomena alluded to that are important factors in its cause. The action of the steam gauge and its indication of pressure should have been observed. A combined pressure and vacuum gauge is often necessary as an indicator of what is going on upon the inside of the boiler. We have often seen a closed circulation heating apparatus under full action as to heat, with the steam gauge index at 5 inches on the vacuum scale, *i. e.*, 2½ pounds less than no pressure, with the water so much in agitation as to be plainly heard, as in a boiling condition. At such times the water in the gauge will vibrate in the same manner as when a boiler is said to be priming.

The height at which the water is kept above the tubes, or the proportion of steam room, as well as the ratio of steam liberating surface to its generating surface, has much to do with the intensity of these actions. Some engineers are in the habit, through a mistaken idea in regard to safety, of carrying the water very high, even to more than half the distance between the tubes and the top of the shell, in cylindrical tubular boilers, which largely increases their disposition to foam by the decreased area of water surface and steam space.

When the heating apparatus is under full steam, and all of the radiators free from air, with air cocks closed, if the fire is allowed to slacken, either by burning out or opening the fire doors, the steam gauge hand will be noticed to move back to zero; and if a vacuum gauge is used, the hand will often move back upon the vacuum side of the zero point, while the radiators will still continue hot for a time; then if the ingress of air could be prevented, the apparatus would continue to steam at a slightly decreased temperature for an indefinite time. For a short time while the pressure is falling the phenomena of foaming or priming takes place, when the boiler will sing like a tea kettle. The foaming under this condition is because the condition and capacity of the radiating surfaces of the apparatus remain in full operation, while the capacity of the boiler for generating steam is slackened, thus drawing away steam and carrying the pressure to less than nothing; thereby lowering the boiling point of the water due to pressure, and setting it into strong ebullition, in order to equalize the latent heat stored in the water at the higher pressure.

This only continues for a short time, or until the equilibrium is restored. This is no part of the phenomenon observed in boilers that foam when the water is foul with sediment and gummy substances accumulating from feed water holding mineral or vegetable matter in solution.

Boilers that are too small for the work they are sometimes forced to do, or that have too small water surface in proportion to their heating surface, are easy foamers when forced up to their nominal capacity. The supposed foaming, mentioned by our correspondent as being checked by jarring the fire door, was probably caused by what is commonly called (we think erroneously) "back draught," or the *vibration* of the gases or products of combustion in the fire chamber and tubes, which acts much in the same manner as the vibrating air within the great pipes of our largest church organs, which are equal to the setting of a large edifice into a synchronal vibration. The vibration of gases under the shell and within the tubes soon extends its influence to the boiler and also to the water. The sudden starting of a vibratory movement within a boiler while steaming tends to increase the liberation of steam for a moment, until an equilibrium is established, during which the foaming may be observed by the action of the water gauge. This is injurious to boilers, and should not be permitted. The cause of the vibration may arise from various conditions, such as a strong draught with solid fire and loosely fitted doors; the air rushing by the edges of the doors sets them to vibrating, which in turn starts a synchronal vibration through all the passages and also to the boiler.

THE percentage of recruits in the Italian army who can neither read nor write varies from 27 in Piedmont to 74 in Sicily.

## CAILLETET'S APPARATUS FOR THE LIQUEFACTION OF GASES.

On the occasion of the Easter sessions of the Physical Society of Paris, Mr. Cailletet exhibited in the halls of the Observatory the apparatus that he used for demonstrating the fact that all gases (even oxygen, nitrogen, and hydrogen, that were formerly regarded as permanent) obey the general law, and may, like all other bodies, exist in three states—solid, liquid, and gaseous. As we have already described this apparatus, we shall not dwell upon it now, but shall merely say that it is at present in use in all laboratories, and that it has recently been applied in some interesting biological researches. Mr. Regnard, at the Sorbonne, and Mr. Certes, in conjunction with Mr. Pasteur, are studying life under high pressures, and are readily obtaining in the receiver of the apparatus such phenomena connected with pressure as were observed by Mr. Milne Edwards during the submarine explorations of the Travailleur and the Talisman.

With Mr. Cailletet's apparatus it is possible to obtain pressures of more than one thousand atmospheres and to maintain these for weeks at a time. Herein is a new and fertile field of research which promises results of great interest to science.

Mr. Cailletet likewise exhibited the mercurial piston pump that he employed for liquefying large quantities of carbonic acid and protoxide of nitrogen for use in laboratories in the production of low temperatures, and for condensing in strong steel receivers the ethylene and formene that permitted him to lower the temperature of substances to much below the point that had ever before been reached. Ethylene, or bicarbonated hydrogen, requires for its liquefaction a much greater pressure than that which is necessary for the condensation of carbonic acid, but the operation is easily effected with Mr. Cailletet's pump, this, when actuated by manual power, being capable of furnishing more than 500 grammes of ethylene per hour. As well known, all solids or liquids, upon entering the gaseous state, absorb a large amount of heat. Alcohol, or better still ether, when poured into one's hand, produces a sensation of cold, and, in surgical operations, this may be carried so far as to deaden all pain through the paralysis of the organs that are to be operated upon. The depression of temperature that ethylene effects upon evaporating is —104°; and, when its ebullition is hastened by means of an air pump (as Faraday pointed out with regard to protoxide of nitrogen), we obtain —142°. Upon cooling a glass vessel containing hydrogen in ethylene boiling at the pressure of the atmosphere, Mr. Cailletet perceived, at the moment the pressure began to diminish, that the liquefied oxygen was assuming the gaseous state and foaming just as champagne wine does upon coming from the bottle. Subsequently Mr. Wroblewski and one of his compatriots, in operating with the Cailletet apparatus, and with the use of a vacuum for hastening the evaporation of the ethylene, succeeded in obtaining quite large quantities of liquefied oxygen.

Under such effect of cold, nitrogen, oxygen, and atmospheric air resolve themselves into colorless, transparent liquids, of extreme mobility, which, upon passing over to the gaseous state, become the source of a cold that descends to —200°. Prof. Olszewski, of Cracow, announced last week at the Academy of Sciences that hydrogen, the most intractable of gases, when submitted to this excessive degree of cold, condenses in the form of a transparent liquid, which, at the moment of expansion, flows over the sides of the glass vessel. Hydrogen is not, then, a solid metallic body, as has been believed, but seems to be, as far as its appearance is concerned, in all respects like liquefied oxygen and nitrogen.

Formene, or marsh gas, can be obtained in a liquid state only at a low temperature and under a high pressure. The experiments that Mr. Cailletet has performed upon this gas have shown him that it produces, upon boiling, a much intenser cold than that obtained through the ebullition of ethylene.

The apparatus that have hitherto been employed for liquefying gases through compression have presented serious drawbacks—the dead space that always exists between the compressing cylinder and the bottom of the pump chamber limiting the pressure that is obtainable. Mr. Cailletet has completely surmounted this serious trouble by substituting a mercurial piston for the use that has generally been employed. A cylindrical rod, A (Fig. 2), covered with mercury, has an alternating motion in a cylinder, B B, and the compressed gas raises an ebonite valve, S, and flows through a tube, T, into the steel receptacle that is to hold it.

The dead space is thus avoided, since the mercury, upon touching the valve, S, at every revolution of the pump, permits not a trace of gas to remain in the cylinder. Pieces of leather, *a* and *b*, placed at the base of the cylinder, prevent a re-entrance of the air during suction and an exit of the gas during compression.




Fig. 2.

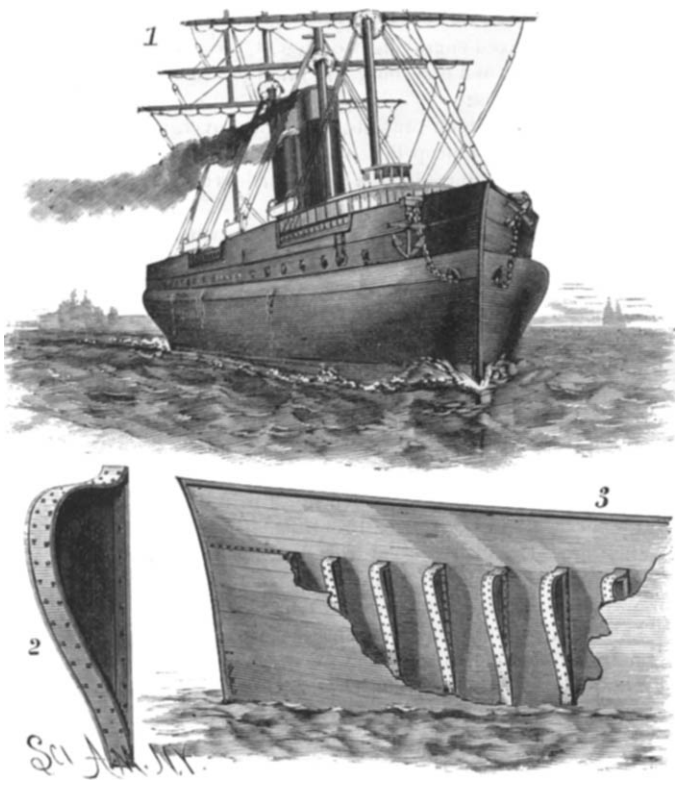
Mr. Cailletet has also substituted a sort of cock, R, for the suction valve of the former apparatus, and this is opened and closed by cams arranged upon the shaft of the fly-wheel.

In Fig. 1 we show the arrangement employed for the production of liquid carbonic acid. The gas, which is prepared by the action of hydrochloric acid upon white marble, is washed in a bottle having two tubulures, dried over calcium chloride, and then sucked up by the pump and forced into a steel flask which is kept cool in a mixture of ice and salt, thus singularly facilitating the liquefaction. One man, by turning the winch affixed to the flywheel, can manufacture from 400 to 500 grammes of liquefied carbonic acid per hour.

The protoxide of nitrogen, as well as the other condensed gases that are employed for obtaining very low temperatures, must be prepared beforehand and stored up in gasometers. Their liquefaction presents no peculiarity, and the pressure that they are undergoing is made known at every instant by the metallic pressure gauge affixed to the apparatus.

In short, Mr. Cailletet's pump is simple in construction and very compact. It is very easily maneuvered, and the use of it has permitted of the liquefaction of not only carbonic acid and protoxide of nitrogen, but also of the ethylene that is used for preparing liquid oxygen.—*La Nature.*

NOTE.—In the SCIENTIFIC AMERICAN of June 21, are illustrations of the industrial applications of the Cailletet process.




LAMBART'S WATER-TIGHT COMPARTMENTS FOR STEAMSHIPS.

## NOVEL ARRANGEMENT OF WATER-TIGHT COMPARTMENTS.

The accompanying engraving shows the arrangement of water-tight compartments for steamships, designed by Mr. O. H. Lambart, of Vinelynne, New Edinburgh, Ontario, Canada. The upper figure shows a vessel built in accordance with these plans; Fig. 2 shows the air-tight partition, and Fig. 3 the hull, part of the plates being broken away to show the construction and arrangement of the compartments. The water-tight compartments completely surround the ship, thereby very much reducing the danger of foundering at sea. The designer claims that in case of a collision not many of the compartments could be destroyed at once ; that the hull would have an outside protection; and that in case an aperture were made below the water line and the ship were to fill with water, the rim of compartments surrounding the ship would keep her afloat.

It will be observed that this method of building does not interfere with the buoyancy of the ship, since the space occupied by the chambers is above the water line. Neither does this method impair her sailing qualities nor destroy the elegance of her lines.

### Serious if True.

The *Insurance Critic* asserts that there are more than 10,000 steam boilers in New York city, attended by 7,000 men, of whom not one-seventh are believed to be trustworthy and qualified for their responsible work; and yet dynamite cartridges are a terror to many people.

### Gelatine Dynamite.

Explosive gelatine, or gelatine dynamite, is the result of the solution of from 7 to 8 per cent of collodion cotton in nitro-glycerine. When, however, less than that quantity is taken, the substance becomes less firm, and if from 2 to 3 per cent only is used, the product is simply a thickened oil, or gelatinized nitro-glycerine. This gelatinized nitro-glycerine has the great advantage of being capable of being absorbed and retained completely by a much smaller quantity of other substances than nitro-glycerine, and it is possible, therefore, to prepare stable mixtures of an explosive base and gelatinized nitroglycerine. The Nobels now prepare three grades of these new extra dynamites : No. I. consisting of 64·5 per cent of gelatinized nitro glycerine, and 35·5 per cent of an absorbent containing 75 per cent of potash saltpeter, 24 per cent of wood shavings, and 1 per cent of soda ; No. II. being composed of 45 per cent of gelatinized nitroglycerine and 55 per cent of above absorbent; and No. III. being a mixture of 14 per cent of ordinary nitro-glycerine and 86 per cent of an absorbent containing 70 per cent of soda saltpeter, 15 per cent. of sulphur, 14 per cent of charcoal, and 1 per cent of soda. With a charge of 20 grammes the volume of the cavity in the lead cylinders had expanded, using No. I., from 15 cubic centimeters to 1,229 cubic centimeters, No. II. to 886, and No. III to 466 c.c.

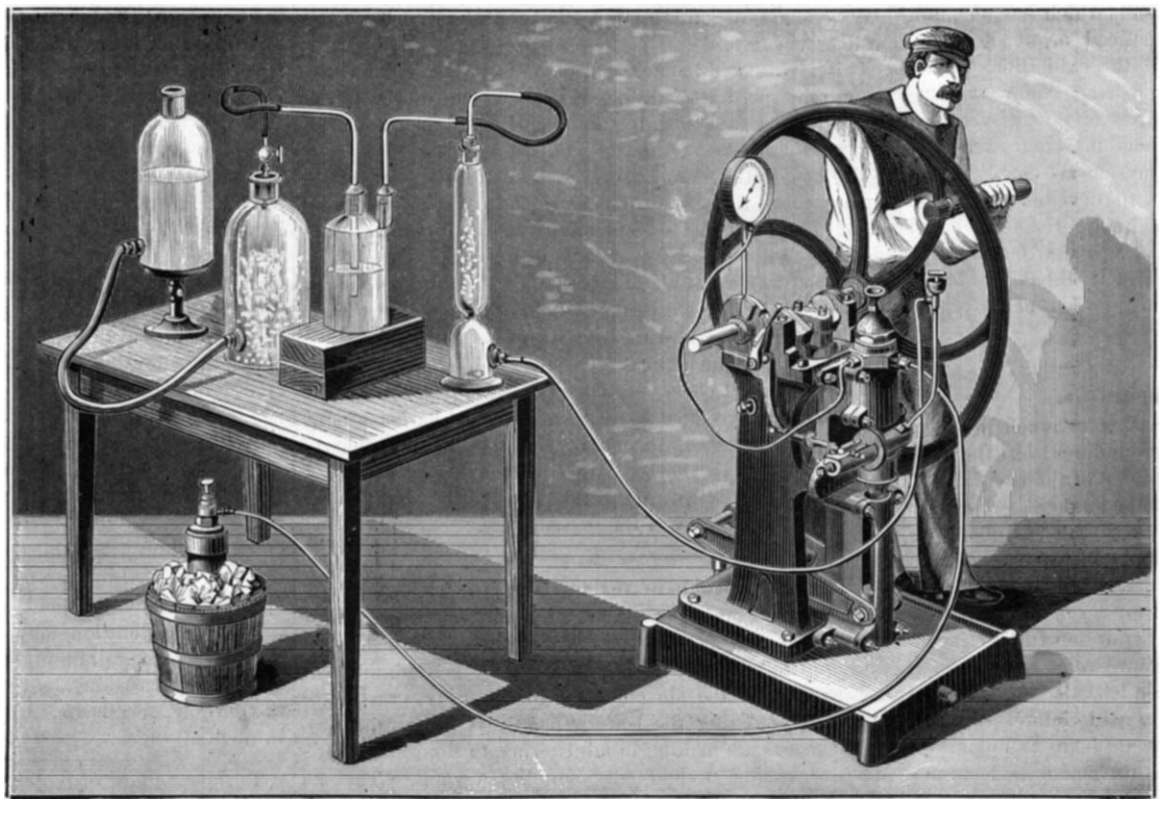


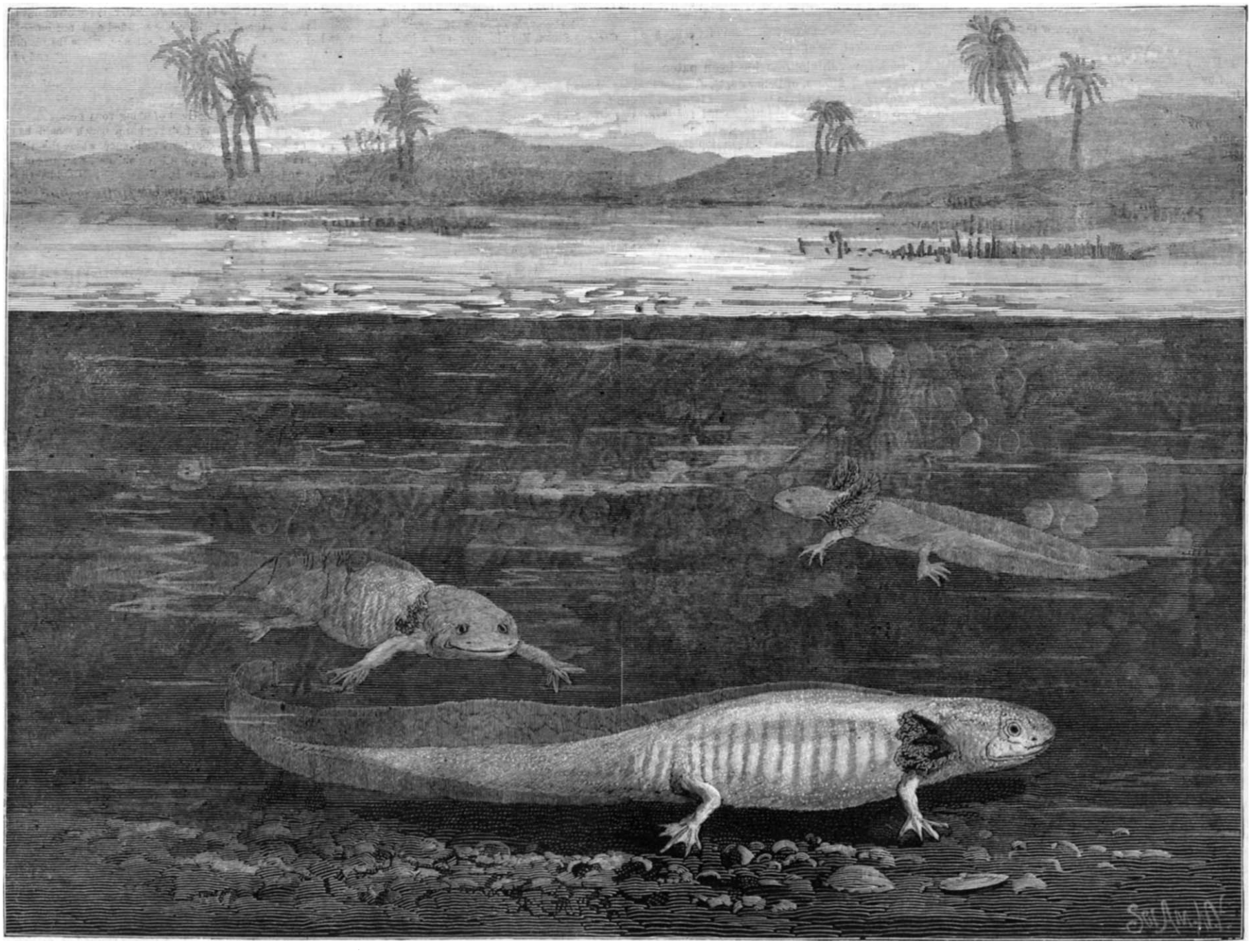
**Fig. 1.—CAILLETET'S NEW MERCURIAL PUMP FOR LIQUEFYING GASES.**

### THE MEXICAN AXOLOTL.

Strange animals, belonging to the batrachian order of reptiles, are those whose appearance our artist has faithfully portrayed. Their structure is familiar to naturalists, but mystery envelops many of their habits, which seem to be in direct variance with the usual order of things, and which do not resemble those found in other reptiles having almost the same structural characteristics.

About two years ago Fish Commissioner Eugene G. Blackford, of this city, received from the late M. Carbonnier, of Paris, a male and female axolotl, which had been raised at the Jardin des Plantes from specimens obtained from Mexico. Generally the color is black or mottled gray, but those sent over were a beautiful, pearl-tinted white. These have been under the care of Prof. H. J. Rice, who is closely studying them in the endeavor to solve many disputed points. The male is now about ten inches long, and while he has changed but slightly in color, the female has become a mottled gray about the head.

A year ago last March, a batch of eggs was laid from which the little one—shown in the background of the engraving—was hatched. Seven months later another batch



THE MEXICAN AXOLOTL.

was laid, and since then laying has occurred at regular intervals of six weeks. In appearance the eggs resemble those of the frog, are about one-sixth of an inch in diameter, and look like balls of glass having a small black speck in the center. Inclosed in this sac of gelatinous matter is the vitellus, or yolk, which after undergoing considerable differentiation develops into what looks exactly like a little black worm, the wriggling movements of which can be easily seen. The water in the tank in which the specimens are kept is renewed once in from two to seven days, depending on the season, and the female deposits her eggs—from 150 to 200—upon the branches of the plants. When exposed to ordinary temperature, the eggs will hatch in about three weeks. Under the microscope the young will show the circulation of the blood all over, except in the darkest parts. It is still a question whether fecundation takes place in the female or upon the eggs after they have been hatched.

Although in a natural state the color of the axolotl is black or gray, these are nearly white, and even the largest one is semi-transparent in certain parts; in all cases the eyes are black. Upon the front legs there are four toes and upon the hind ones five. The toes on the left hind leg of the female are worn away; this was probably caused by crawling about on the gravel in the bottom of the aquarium, and if she could be placed in her natural surroundings of mud they would grow out again. The dorsal fin continues around the end of the tail to the anus, and is almost perfectly transparent.

The gills are external and are formed by thin pairs of branchial veins, the ends of which are covered by a long and slender fringe, or capillary network, of a dark pink color. The returning channels converge to form the branchial arteries, which enter the neck, curve along the walls of the pharynx, and unite to form the right and left aortæ. The fourth pair pass backward, and each divides, the larger portion going to the lungs, and the other to the back of the œsophagus. Under certain conditions the gills will become absorbed and the reptile will leave the water, becoming a land animal. This does not always occur, and the governing conditions are not known. The gills of this female have dwarfed since she began laying, and she frequently comes to the surface of the water for a gulp of air. A strange fact about the axolotl is that it reproduces while it is a water animal, but, so far as at present known, not after it undergoes transformation and becomes a land animal.

It is stated that the axolotl is used as food by some of the natives of Mexico, and has been considered a delicacy since the time of Cortez, while others, especially the women, hold it in abhorrence and make it the foundation of many curious superstitions. A similar or closely allied species is found in some of the Southwestern States. The axolotl takes his food at a gulp, holds it in his mouth for a time, munches but does not masticate it, as we understand that term, and then swallows it. In a native state it is probable that he takes a mouthful of mud, from which the nutritive matter is absorbed and the balance thrown out.

### Unhealthy Workrooms.

Very few people have any idea of the conditions under which much of the manufacture of ready-made clothing is carried on in our large cities. The great extent of the trade, and the strong competition which exists in it, result on the one hand in the employment of large numbers of women to run the machines and do finishing work of various kinds, and on the other hand in attempts to reduce the cost of their employment in every possible way, not only by paying very small wages, but by crowding them in ill-ventilated rooms, and furnishing the least possible accommodation for them. It is true, remarks the *Sanitary Engineer*, that this is not always the case, and that there are some employers on a large scale of this kind of labor, who are wise and kind enough to provide large, airy, well-lighted rooms for their workwomen, but some of the subcontractors and managers of small establishments, to whom may properly be applied the terribly significant name of "sweaters," give little or no consideration to the health of their employes.

It is true that little complaint is made by the latter; even when they are questioned they will be exceedingly careful to say nothing that will seem to reflect on their employer, and it is by no means easy to see how their condition is to be improved. The English Government has tried its hand at legislation on this subject, but the results, as given in a recent number of the London *Lancet*, in the form of a special report on the Polish colony of Jew tailors in London, are not very encouraging. It seems that owing to the recent exodus from Russia there are now some 30,000 Russo-Polish Jews huddled in colonies in the east end of London, most of them miserably poor, unable to speak English, and almost absolutely dependent on "sweaters" for employment. They are ready to accept starvation wages, and to aid their employers in defying factory acts, sanitary acts, and other acts designed to protect them, but which, with their connivance, are practically, to a great extent, a dead letter. They are, moreover, ignorant of the use of modern sanitary appliances.

The *Lancet* reporter refers to one colony of about 150 persons, where some of the rooms are so dark that candles must be used in the middle of the day, and out of fifteen water closets four were broken and only one clean. "Though provided with a waste preventer and a flush of nine gallons, the whole system was so foreign to the inhabitants that they had not yet learnt to pull the chain so as to flush and clear the pan." In another colony the closets were so neglected and damaged that they were removed to the yard, the result of which is that the inhabitants instead of going down stairs simply throw the excreta out of the windows.

We have this same class of people in the tenement house population of our own cities, notably in New York and Chicago, and their brutal ignorance and liking for filth must be taken into account in all plans for improvement. But where they are willing and able to work at such a trade as tailoring, it certainly ought to be possible to insist that they shall have enough light and fresh air in their workrooms, and the more so since in the long run this is to the advantage of the employer as well.

Under the most favorable circumstances the trade is not a healthy one, but in crowded rooms, with ceilings only eight or nine feet high, no ventilation, and the air filled with dust and foul organic matters, diseases of the lungs and air passages disable and destroy the occupants with terrible rapidity and certainty.

## ENGINEERING INVENTIONS.

A gauge cock has been patented by Mr. Charles B. Rogers, of St. Peter, Minn. The invention is specially applicable to that class of steam boilers where it becomes necessary, on account of the height of the boiler, to lead the gauge water and steam down by means of pipes attached to the gauge cocks, for which special novel devices are provided.

A process of treating iron has been patented by Mr. Brock Woodruff, of Albert Lea, Minn. This invention covers the treating of iron with a mixture of sand, salt, and black oxide of manganese, subject to alternate heating and cooling of the metal, and thus making an iron for rails, plows, journals, bearings, etc., where hardness and toughness is required.

The art of constructing tunnels is the subject of a patent issued to Mr. De Witt C. Haskin, of New York city. The invention covers the use of iron plates to form a projecting hood in advancing a tunnel excavation, and various other improvements, such as have been in practical use in the building of the Hudson River tunnel between New York and Jersey City.

A coke oven has been patented by Mr. Jonathan Green, of Leisenring, Pa. The invention covers the use of a cradle of gas pipe arranged over the oven bottom, with fine perforations for distributing steam or hot air, or for the application of hot blasts, the cradle being also contrived for quickly discharging the coke, by the application of power, with other novel devices.

A railway signal for locomotives has been patented by Mr. Joseph J. Stoetzel, of La Salle, Ill. The invention provides for an arm pivoted to swing vertically on the locomotive, moving up and down automatically by fixed inclined rails or ways set at suitable points along the side of the track, the arm being so connected as to ring the bell of the locomotive as desired.

An ore concentrator has been patented by Messrs. William B. Kennedy and Watson M. Nesbitt, of Silver Reef, Utah Ter. In combination with a sluiceway are independent detachable agitators and governors, with other novel features, to more effectually wash and separate the ores, and remove the concentrates from the sluiceway, than has been heretofore possible.

A speed clock for machinery has been patented by Mr. William H. Lord, of New York city. The clock works are made the same as for an ordinary clock, but the worm wheel that carries the speed hand is supported and separated from the time clock works by a bridge and hollow journal, there being hands which revolve one in sixty hours, one in sixty minutes, and one in sixty seconds, to show the loss or gain in speed of an engine or other machinery.

## MECHANICAL INVENTIONS.

A mechanism for converting motion has been patented by Mr. Norman D. Wells, of Hastings, Minn. It is designed for converting reciprocating into rotary motion, and consists in a novel construction of operating pawls, arms, and friction bands, and in mechanism for reversing motion.

A gauge for adjusting planer knives has been patented by Mr. Francis B. Thompson, of Beaumont, Texas. It is designed for use in planing mills to hold the side heads in best position for filing, sharpening, or setting the bits, affording a strong machine for holding the side heads firmly as the workman may desire.

## AGRICULTURAL INVENTIONS.

A gang plow canting device has been patented by Mr. Wm. Kimmel, of Milton, Ind. Each plow has two independent hitching rods to connect it with the truck, to which a lever is pivoted with a latch, so the rod may be easily raised or lowered to cant the plow.

A seed sower has been patented by Mr. William H. Thomas, of Fulton, Mo. The object of this invention is to sow seed from the rear end of a wagon by the assistance of a person riding in the wagon, for which there is a special wagon attachment of novel construction.

## MISCELLANEOUS INVENTIONS.

A dinner pail has been patented by Mr. Thomas F. Freel, of New York city. It has perforations in the middle part of its cover, to allow of air circulation, and curved wires so attached that a cup can be carried without obstructing the passage of air.

A pendant, which is simple and ornamental, has been patented by Mr. Bernhard Dreyfus, of New York city. A cresent shaped flanged holder is made to carry two pendants or drops, and a ball may also be suspended between the pendants.

A stove pipe damper has been patented by Mr. William E. Beilman, of Buffalo, N. Y. This invention covers improved means of connecting the pivot rod for adaptation to dampers of different sizes, and is applicable as well to hot air pipes as to smoke pipes.

A folding egg case has been patented by Mr. William G. Ruge, of Washington, Mo. The case has upwardly projecting screws on fixed and hinged end pieces, with a cover on which nuts are held to be rotated by wires through annular grooves in the nuts, and the box has a removable partition.

An electric register for fluid reservoirs has been patented by Mr. Charles S. Lockwood, of Newburg, N. Y. The apparatus is actuated by the rise and fall of the fluid, thus making and breaking an electric circuit connected with electro mechanical registering mechanism.

A skate sharpener has been patented by Mr. Xavier St. Pierre, of Osceola, Nevada. This invention covers a novel shaped file, and holder therefor, affording a convenient device for sharpening the runners of a skate, and one with which no difficulty will be experienced in forming a uniform gutter.

A fence post has been patented by Mr. John C. Fiero, of Milo Center, N. Y. It is of wrought iron, made of a single rod bent at its middle, the two halves being brought close together and parallel to form the body of the post, and the ends made to diverge outward and inward to form legs or braces.

A stove pipe thimble has been patented by Mr. Godfried Laube, of Huron, Dakota Ter. It has a flaring outer end large enough to admit the bead of the stove pipe a suitable distance for being secured by screws screwing obliquely through the outer end of the thimble against the bead.

A compound for the manufacture of artificial stone has been patented by Mr. Hermann Bening, of New York city. It consists of Rosedale or Portland cement, oxalic acid, chalk, muriatic acid, iron filings, and water, in specified proportions, and compounded in a special way.

An improved fire proof building is the subject of a patent issued to Mr. William H. Dolman, of Brunswick, Mo. The patent relates to former improvements patented by the same inventor, and covers the application of ashes, dry earth, etc., for protecting the joists and other woodwork of buildings from fire.

An improved grate has been patented by Mr. John T. Synder, of Luzerne, Pa. This invention provides for a grate capable of clearing the fire of clinkers automatically by the rocking of the grate on its bearings, securing a better regulation of the fire and a more economical use of fuel.

A hood for vehicle tops has been patented by Mr. Charles T. Shreve, of Delaware, N. J. The invention covers a plate made in two parts, connected by hinges, so the hood can be readily folded for transportation, the object being to afford better protection from rain and snow to persons riding in top carriages.

A hitching strap has been patented by Mr. Samuel Birdsall, of Susquehanna, Pa. It is made with a brace strap connected with the tie strap by a bolt, nut, and washer, or other suitable coupling, so the brace strap will be firmly connected with the tie strap, and can be readily swung to either side.

A dump cart has been patented by Mr. Robert Clark, of Brockville, Ontario, Canada. This invention covers a special construction and combination of parts, for both wagon and harness, so that the weight upon the cart tongue bears directly upon the saddles of the horses, and they are enabled to carry the load naturally.

A refrigerator has been patented by Mr. Isaac T. Dyer, of Quincy, Ill. The ice rack is formed of a series of vertically movable troughs or gutters, and the openings through which the cold air can pass from the ice into the refrigerating chamber can be regulated at will, the refrigerator being easily taken apart for packing and cleaning.

A revolving double trapeze has been patented by Mr. Edward J. Leamy, of Syracuse, N. Y. The invention consists in a centrally pivoted frame, with means on one of the pivots for revolving the frame, from each end of which a frame is suspended, the trapeze being adapted to be revolved on its transverse central axis.

A spark arrester has been patented by Messrs. Elias B. Baldwin and Effenger R. Kline, of Sayre, Pa. Combined with the smoke box is an outlet pipe extending downward and backward, and there is a winged wheel on a shaft in front of the outlet ends of the exhaust pipes, the wheel being operated by the exhaust steam.

A sink spout has been patented by Mr. John G. Coburn, of South Carthage, Me. The object of the invention is to make a sink spout that may be easily thawed out when frozen, and for this purpose an additional pipe extends from a perforated top along one side of the waste pipe, a cup affixed to the additional pipe allowing of hot water to be poured therein.

A fire escape has been patented by Mr. Thomas Hale, of Claydon, Eng. The invention covers a novel construction and arrangement of parts, making a distinctive supporting and lowering apparatus, the supporting frame being light and easily applied in a window opening, and the lowering apparatus consisting of a canvas bag distended by a hoop, and suspended by a metal yoke or branch ropes.

A compound and self-acting plug valve for wash basins has been patented by Mr. Thomas P. Ford, Jr., of Brooklyn, N. Y. Rigidly connected valves are fitted in the supply and discharge pipes, so that one shall close as the other opens, and *vice versa*. There are also special contrivances to prevent waste, and to seal the outlet valve against the escape of noxious gases.

An apparatus for treating leather stock with naphtha to extract oils has been patented by Mr. Frank F. Newell, of Chelsea, Mass. A water tank surrounds the lower part of the naphtha tank, and there is a steam pipe and coil for heating the interior of the naphtha tank, by which the naphtha-extracted leather stock may be so treated that the vapor expelled in drying can be regained.

A rotary peg cutter has been patented by Mr. John L. Coleman, Jr., of Wattsborough, Va. The invention covers a disk with two sets of oppositely disposed cutters, the disk being journaled in a pivoted support and receiving a rapid rotary and slow oscillating motion; and it may be operated by hand, foot, or other power, as desired by either dealer or manufacturer.

A gas and lamp bracket has been patented by Henry P. Drew, of New York city. The object of the invention is to prevent gas burners and lamps from being swung against the walls or window curtains; the bracket is two jointed, with an adjustable cross bar so arranged that the pipe between the joints can be held stationary or allowed to move as desired to either side, with other novel devices. The same inventor has obtained another patent covering similar improvements for a one-jointed gas or lamp bracket, with an adjustable cross bar connected with the joint, for a like purpose.

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The above is the title of a volume of 360 pages from the pen of Mr. A. Wazon, civil engineer, upon the subject of how to supply our cities with water, which has always been one of great importance, and which becomes of increasing moment with the rapid growth of population in our large cities. The greater part of the work is devoted to the subject of drainage of our cities and dwellings, and the proper plumbing and sewerage of our houses. The treatment is quite different from that which the work would receive at the hands of an American or English writer, but the matter is of interest to an American, as the subject is carried one step further than it would be here; the methods employed in converting refuse from the sewage pipes into valuable fertilizers is taken up and discussed. Mr. Wazon conducts his investigations by following the course of the pure water from its several natural sources until it is distributed into a common reservoir; he next notes its course after it has become impure and has been discharged from houses and residences until it mixes with the water from the public highways in the common sewer. Then the course of the sewer water is followed until it reaches the place where it is purified and portions of it become of great value as fertilizers, while the residue, which is for the most part water, is cleansed and of a purity almost equal to that which it possessed when first delivered at the reservoir. This water is then conducted to some neighboring stream, and thus carried away to the sea, deprived of dangerous germs and of that invisible power of doing harm which would be so incalculable in a country like France, where the rivers are small and the population so dense, were it not for some such system as this. This work is published by Baudry & Co., 15 Rue des Saints-Peres, Paris, France. Price 15 francs.

## Notes & Queries

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**Scientific American Supplements** referred to may be had at the office. Price 10 cents each.
**Minerals** sent for examination should be distinctly marked or labeled.

(1) E. E. H.—In making plaster of Paris moulds for rubber stamps the type is first rubbed full of hard soap, the soap is then removed from the surface of the type by means of a brush and water, leaving the deep parts filled with soap. A rather thick layer of very fine plaster of Paris is now poured over the type and allowed to set. There are two ways of making the stamp from this mould. One is to take elastic rubber already vulcanized and lay it over the plaster mould and apply pressure like a spring, and then boil the whole in salt water for some time, until the rubber is forced into the interstices of the mould, then allow the whole to cool together before trying to separate the rubber from the mould. Another method is to place the unvulcanized rubber in a flask containing the mould, and then place the whole in a vulcanizer for some time under steam heat and pressure.

(2) G. E. W. asks (1) what metal will expand most at a degree of heat of 104, same being in shape of rod five-sixteenths or three-eighths inch. A. Zinc. 2. Do you know of any chemicals that will harden plows, and by what process, same as when come from plow factory. A. A simple method of casehardening iron is to sprinkle powdered potassium ferrocyanide (prussiate of potash) over the articles at a red heat, and then plunge into water. Potassium bichromate with the pith of rams' horns may be used with good results. The method is described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 23.

(3) T. B. asks (1) how steel lower dies are struck up from the upper or hub die; whether they are struck up when hot, or the steel made soft and then struck cold, and how steel is made very soft for that purpose? He has tried it in hot steel under a drop press, but finds that the fine lines do not come up. A. Steel dies for drop press work are struck up hot, if deep, so as to get the general depression. They are then annealed, and the scale cleaned off with muriatic acid and water, equal parts; give the die a partial polish, and finish the figure under the drop cold. Flat work dies may be struck up cold. To soften a steel die for stamping or a hob for cutting, heat to a full or cherry red, let it cool in a heap of hot ashes or lime. When it loses its red color or you no longer see it red in the dark, souse it in water; this is called water annealing. If the fine lines do not come up after the first trial, put some soap upon the surface of the die and anneal again. The soap keeps it from scaling. Clean the surface at each annealing with acid as above. You can perfect the die in this way. 2. Also how stereotype moulds are made, of what kind of paper, if it can be bought already prepared, and how stereotype metal is made? A. The following is the process for casting stereoplates by the paper process: Lay a sheet of tissue paper upon a perfectly flat surface and paste a soft piece of printing paper, which must be pressed evenly on to the tissue. Lay the paper on the form previously oiled,

and cover with a damp rag; beat with a stiff brush the paper in evenly, then paste a piece of blotting paper, and repeat the beating in; after which about three more pieces of soft, tenacious paper must be pasted and used in a similar way; back up with a piece of cartridge paper. The whole must then be dried with moderate heat under a slight pressure. When thoroughly dry, brush well over with plumbago or French chalk. When this is done, it is ready for the matrix. This is a box of a certain size for the work required, the interior of which is type high. In it is what is termed a gauge, which lifts out to insert your paper cast, and is regulated by hand to the size of the plate required. This being placed inside, the lid is shut down and screwed tight with the end or mouth piece left open. By this orifice the metal is poured in, and as it is mounted to swing, the box is moved about so as to well throw down the metal and make a solid cast. Then water is dashed on the box, the screw bar unshackled, the lid lifted, and the paper cast is again ready for work. Stereotype metal consists of one part tin, one part antimony, and four parts of lead. In using stereotype metal, brush the type with plumbago or a small quantity of oil, then place in a frame, and take a cast with plaster of Paris.

(4) S. C. T. asks: 1. What causes steam boilers to foam, and can it be prevented? A. The foam results from dirt in the boiler, probably resulting from using an impure water. It can be remedied by the employment of anti-incrustation agents; see SCIENTIFIC AMERICAN SUPPLEMENT, No. 286, for full information on this subject. 2. How he can mend a crack or break in a piece of marble on a table, color not an object. A. The following is the recipe for cement used by marble workers: Flowers of sulphur 1 part, hydrochlorate of ammonia 2 parts, iron filings 16 parts. The above substances must be reduced to a powder, and securely kept in closely stoppered vessels. When the cement is to be employed, take 20 parts very fine iron filings, add 1 part of the above powder. Mix them together with enough water to form a manageable paste. This paste solidifies in 20 days, and becomes as hard as iron.

(5) G. H. P. asks how to stain a gun stock in imitation of rosewood, the stock being made of black cherry. A. For the rosewood stain use the following: Take 1 gallon alcohol, 2 ounces of camwood, set them in a warm place twenty-four hours; then add extract of logwood 3 ounces, aquafortis 1 ounce, and when dissolved, it is ready for use; it makes a very bright ground, like the most beautiful rosewood. Use one, two, or more coats as you may desire. 2. What is used to blue a gun barrel? A. Gun barrels are blued by applying nitric acid and letting it eat into the iron a little, then the latter will be covered with a thin film of oxide. Clean the barrel, oil, and burnish.

(6) J. M. E. asks directions for making a good varnish for paint that will stand the weather for doors, or if there is such a varnish. A. To make a good varnish is a trade in itself. Purchase a wearing body varnish, the make of any well known manufacturer.

(7) J. A. C. asks: What is used to make the gold lines in the tracings on musical instruments and marble mantels, etc.? A. If none of the bronze powders prove satisfactory, we would recommend you to procure the real gold bronze, and then coat the work when finished with some transparent varnish.

(8) H. H. writes: Some time ago you gave a formula for removing black heads and pimples, consisting of kaolin 4 parts, glycerine 3 parts, acetic acid 2 parts, with a small quantity of ethereal oil. I had the above mixed, but it has a very disagreeable smell. What can I use to give it an agreeable odor? A. We fear you have neglected to add the "small quantity of ethereal oil," such as oil of rose, oil of cloves, essence of lemon, of bergamot, etc.

(9) F. H. asks the receipt for making the preparation which is used on ribbon stamps to renew the ribbon when the color comes out. A. Dissolve ¼ ounce carmine in 2 ounces strong ammonium hydroxide, or else ¼ ounce aniline color of suitable shade in same quantity water and add 1 drachm of glycerine and ¾ oz. of dextrine.

(10) R. H. asks (1) whether there is a firm manufacturing paper pipe of the same material used in making car wheels. Iron pipe rusts so rapidly in our damp, sandy soil that we thought pipe made of paper would answer better. A. We understand that paper pipe, made by rolling thick paper asphalted upon mandrels and cementing by heating, has been made and used in France. We do not know of its being made or in use in the United States. Galvanized iron pipe is now used generally underground except for the larger sizes, in which cast iron is preferred; both are durable. 2. Would also like your opinion as to whether or not water can be drawn through a 3 inch pipe a distance of 3,000 feet with gradual elevation of 25 or 27 feet with steam pump. Our factory is about that distance from a lake and about that height above the level of it, and we would like to know if we can draw our supply of water from the lake, as our wells are almost dry. A. Yes, but you will have some trouble in getting the water started in so long suction.

(11) T. D. M. asks: 1. What is the best treatment, both preventive and cure, for puppies from one to three months old that have round worms four or five inches long; I think they are the *Ascaris marginata?* A. For a valuable dog you had better consult one specially skilled in this line; ordinarily, a scant diet for a day or two, and then a good purgative would do. 2. How many pounds of blood does a bullock average on being slaughtered for each 100 pounds he weighs, and what would the blood be worth per pound as a refuse product, and what would be the best manner of disposing of same. A. The amount of blood varies widely; it is mostly used to make a fertilizer, and some of our New York butchers give it away to boys, who save it, for the incidental service they do. It would take the blood of a half dozen ordinary bullocks to make a barrelful.

(12) J. E. H. asks: Suppose I have a wild goose and a tame goose together, and the two produce offspring; will their offspring propagate, and if so, which side would they naturally incline to? A. Crosses between wild and tame animals of the same species have been made with success. All of our domestic birds, fowls, and animals were in the early ages in a wild state. It is very uncertain as to which side they would naturally incline at first, but confinement, or the clipping of the wings of those disposed to fly away, would probably determine their permanent disposition to the tame state definitely.

(13) A. C. P. F. asks (1) a receipt for making birdlime. A. Bird lime is made as follows: Boil the middle bark of the holly 7 or 8 hours in water; drain it, and lay it in heaps in the ground covered with stones for two or three weeks, till reduced to a mucilage. Beat this in a mortar, wash it in rain water, and knead it till free from extraneous matters. Put it into earthen pots, and in four or five days it will be fit for use. An inferior kind is made by boiling linseed oil for some hours, until it becomes a viscid paste. 2. A cement for mending broken flint arrow heads, and that will fasten arrow heads to wood securely instead of wiring them on as some do? A. The following is used for mending fossils and minerals, and will answer, we think, both for the mending and attaching the arrow heads:

| | |
|---|---|
| Starch | 2 drachms. |
| White sugar | 1 ounce. |
| Gum arabic | 2 drachms. |
| Water | q. s. |

Dissolve the gum, add the sugar, and boil until the starch is cooked. 3. Does the earth increase in bulk, or is it no larger than at time of cooling process? A. We refer you to Professor Young's paper on the Growth or the Earth, in SCIENTIFIC AMERICAN SUPPLEMENT, No. 40, where data are given to show exactly how much the earth has increased in size.

(14) C. A. B. asks: 1. How can I temper coiled steel wire springs so that they will not break under a small pressure or pull? A. A good way to temper small coiled wire springs, as practiced in factories where much is to be done, is to heat an iron pot filled with lead so that the lead is a full red or sufficiently hot to heat an immersed spring to the requisite temperature for hardening, which can be done by quickly immersing the hot spring in water or lard oil. Then for drawing to a spring temper heat a small vessel of linseed oil to its boiling point. Dip the springs in the boiling oil for a few seconds (time according to thickness), and plunge them into cold oil. 2. How may I apply black varnish to iron pipes and steel springs so that it will not peel or scale off? A. For varnishing iron pipes and springs use good Japan varnish, a thin coat well baked at 270°. If it proves brittle, mix a little boiled linseed oil with the Japan varnish.

(15) A. M., referring to polished sheets of stove pipe iron being found in a ball of rough ones, writes us that, in making sheet iron of the higher gauges, it is necessary, in order to obtain the required thinness, to roll two or more sheets together. To make 22 gauge it is necessary to roll 4 sheets together; 24 gauge, 5 sheets. These sheets rolled together are called a pack. The top and bottom sheets of a pack, being the ones which come in contact with the rolls, always have a polished surface on one side, while the inside sheets are rough. The manufacturers do not consider these inside or rough sheets of an inferior quality.

(16) E. N. P. asks: 1. Has the cylinder of a phonograph got to be just so large for the machine, or will it make any difference if it is larger or smaller? A. The size is immaterial. 2. What does the piece of rubber tubing rest on, and is it a ferrotype that is put between two pieces of blotting paper? A. The piece of tubing is placed between the inner surface of the mouth piece and the diaphragm. The diaphragm may be made of ferrotype plate. 3. How is the piece of rubber fastened on? A. With cement although it will keep its place without any special fastening. 4. Is the cylinder to be hollow or solid or is there any difference? A. Either solid or hollow. The solid is preferred, as it acts as a fly wheel to equalize the motion.

(17) W. C. W. asks (1) how to make an induction coil. A. Consult SUPPLEMENT No. 160. 2. Also how many 2 quart Daniell cells would be necessary to run an incandescent lamp of 15 candle power? A. It would take a large number of Daniell cells to operate an incandescent lamp. Better use forty or fifty Bunsen cells. 3. Please state the length of the primary and secondary wires in the coil, also their size. I would like one strong enough to make a spark about two inches long. A. See SUPPLEMENT referred to above.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

V. W. H.—We presume the specimen to be tourmaline. It is so very small that it is difficult to determine it positively without an analysis.—C. W. N. K.—The specimen is a sulphide of iron containing arsenic, and is known mineralogically as arsenopyrite.

## INDEX OF INVENTIONS

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**June 17, 1884,**

**AND EACH BEARING THAT DATE.**

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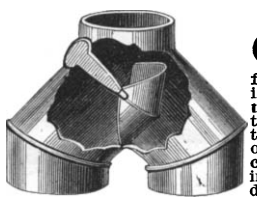
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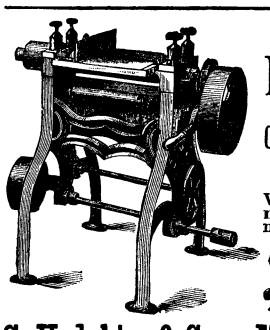
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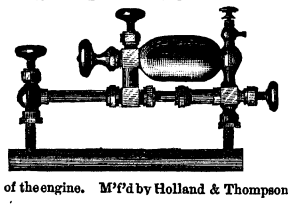
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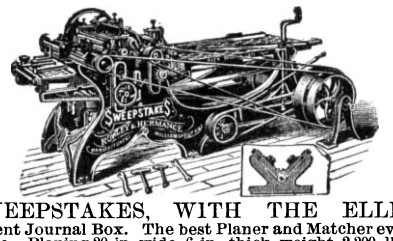

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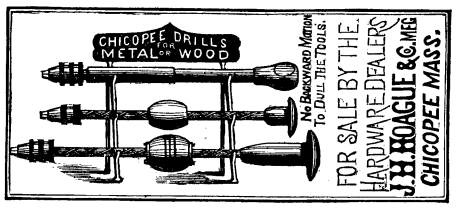
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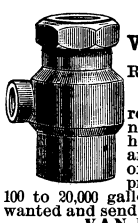
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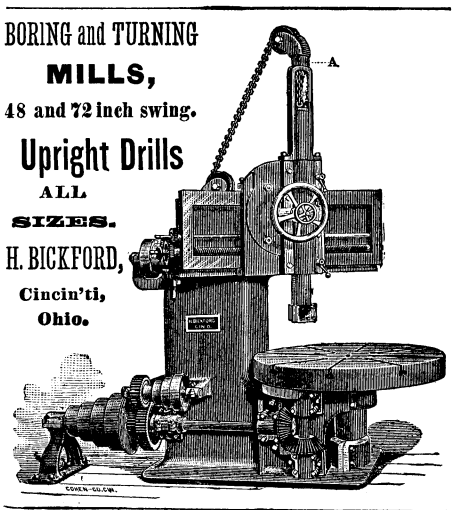


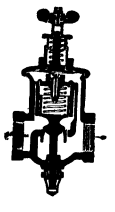
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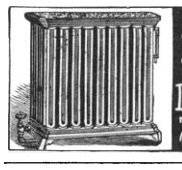
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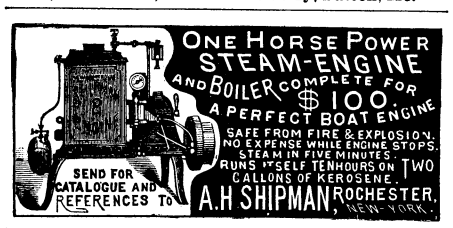
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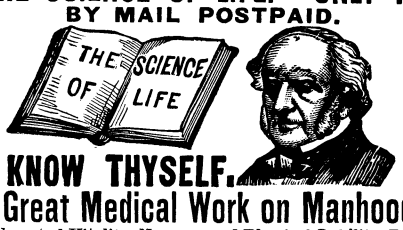


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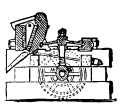

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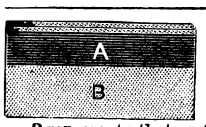


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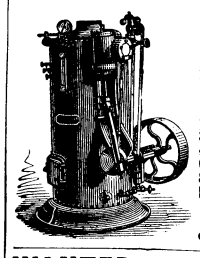

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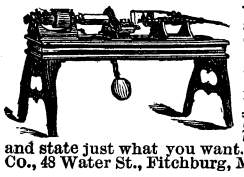

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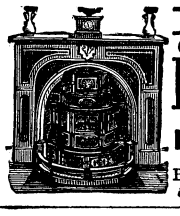

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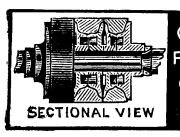


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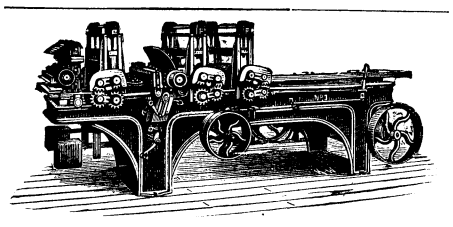

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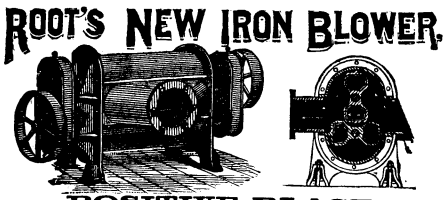

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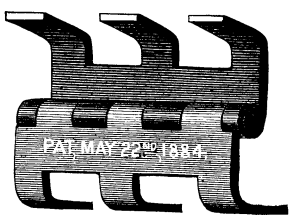


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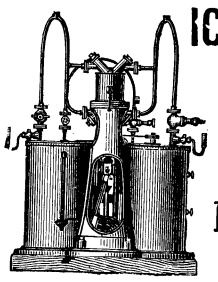

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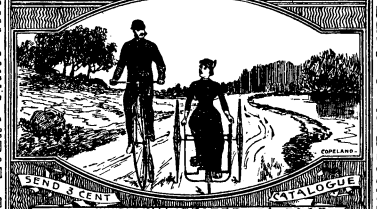

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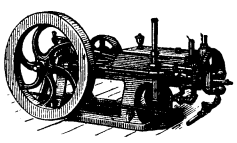

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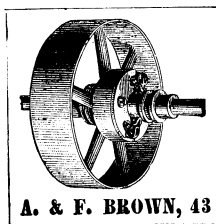

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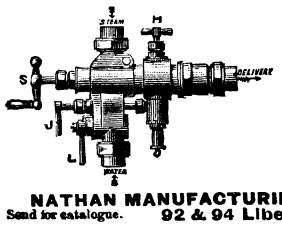

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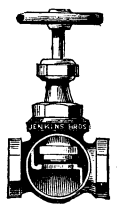

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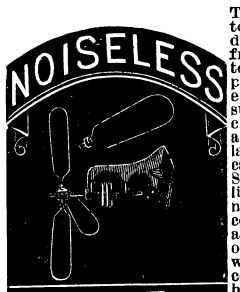


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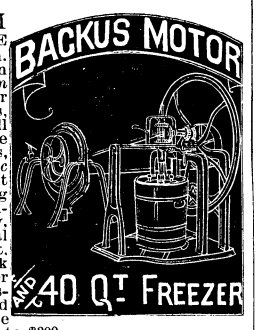


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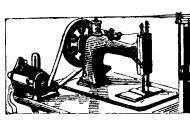

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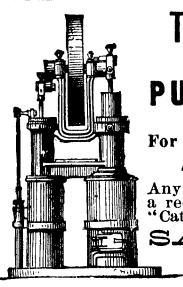

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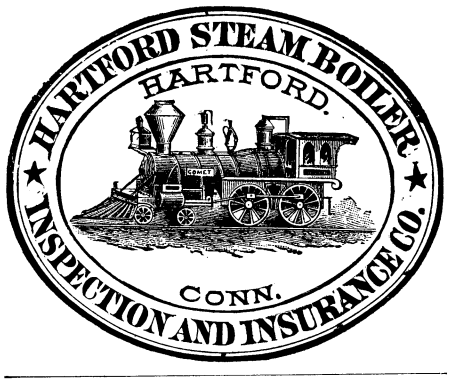


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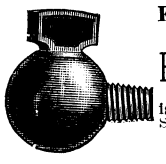

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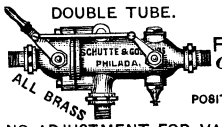


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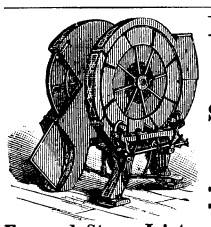

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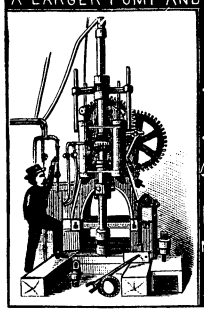

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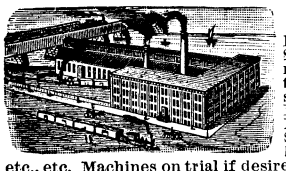

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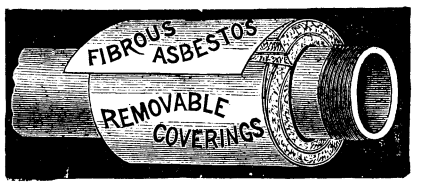


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